CBNSF 22.4.5.3
MWESD 5.2.3
10/20/99

REVISED FINAL

ROUND 1A DATA REPORT

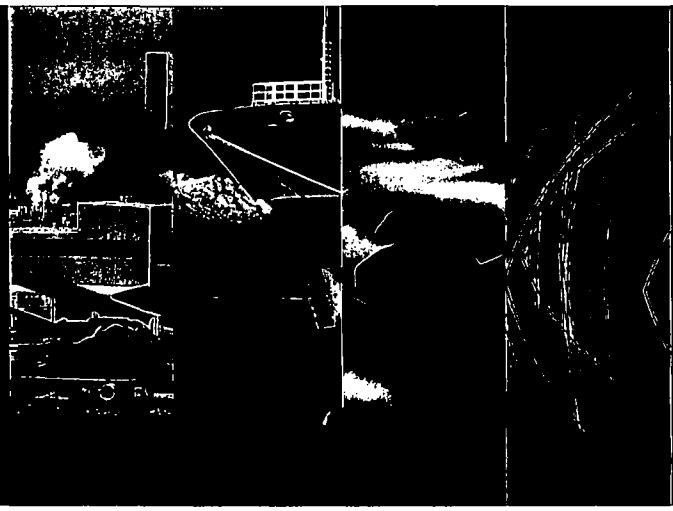
– VOLUME II –

for

Middle Waterway Problem Area

of the

Commencement Bay Nearshore/Tideflats
Superfund Site
Tacoma, Washington



prepared for the:

Middle Waterway Action Committee

MIDDLE WATERWAY

Protecting the Environment, Promoting the Economy

August 23,1999

FOSTER WHEELER ENVIRONMENTAL CORPORATION

ANCHOR ENVIRONMENTAL, L.L.C.

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USEPA SF
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REVISED FINAL
ROUND 1A DATA REPORT
VOLUME II (APPENDICES E TO H)

for

Middle Waterway Problem Area
Commencement Bay
Nearshore/Tideflats Superfund Site
Tacoma, Washington

MIDDLE WATERWAY

Protecting the Environment,
Promoting the Economy

prepared for the:

Middle Waterway Action Committee

prepared by:

Foster Wheeler Environmental Corporation
10900 NE 8th Street
Bellevue, WA 98004-4405
and

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1411 4th Avenue, Suite 1210
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August 23, 1999

REVISED FINAL ROUND 1A DATA REPORT

VOLUME II

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APPENDIX E

APPENDIX E

DATA VALIDATION

CHEMICAL DATA VALIDATION

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 8, 1998
SDG No. 805036

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

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This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, as revised, 1994; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The size of the data packages, the data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWCS028R2A	805036-1	X	X	X	X	X	X	
MWCS028R3A	805036-2	X	X	X	X	X	X	
MWCS028R4A	805036-3	X	X	X	X	X	X	
MWCS031R2A	805036-4	X	X	X	X	X	X	
MWCS031R3A	805036-5	X	X	X	X	X	X	
MWCS031R4A	805036-6	X	X	X	X	X	X	
MWCS040R2A	805036-7	X	X	X	X	X	X	
MWCS040R3A	805036-8	X	X	X	X	X	X	
MWCS040R4A	805036-9	X	X	X	X	X	X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data Package, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Water and Sediments	110 Pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	580 Pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Water and Sediment	276 Pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Water and Sediment	218 Pages	Thomas S. Davis	Lorraine L. Davis
Metals	Water	236 pages	Lorraine L. Davis	Thomas S. Davis
Metals	Sediment	150 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	60 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	26 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	10 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The samples were taken on May 8, 1998 and apparently subsampled on May 11, 1998. The subsamples were received by the laboratory at a temperature of 10.0°C on May 11. A Corrective Action Form was generated stating that the temperature of the samples was out of acceptance criteria of 4 ± 2°C, and there is no supervisory signature indicating approval of the Corrective Action.

In a written response dated October 9, 1998, Foster Wheeler reported that they had been notified of the temperature anomalies and had instructed MultiChem Analytical Services to proceed with the analysis. The lack of supervisory signature approval was an oversight and was corrected on subsequent forms.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

Except as noted below, all initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Calculations for the Response Factor (RF) and Percent Difference (%D) were incorrect for the Continuing Calibration Check analyzed on May 20, 1998 at 0934 on HP2 (Page 74 of the SDG data package). The reviewer was able to recalculate the RF and %D and all results were within criteria. No data qualifier flags are recommended.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The laboratory also analyzed two blank spikes to measure precision and accuracy. All percent recoveries and relative percent differences were within laboratory or method criteria

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS031R2A	1,3-Dichlorobenzene	Internal Standard	3.1 UE
	1,4-Dichlorobenzene		3.1 UE
	1,2-Dichlorobenzene		3.1 UE
	1,2,4-Trichlorobenzene		7.8 UE
MWCS031R2ARE	1,3-Dichlorobenzene	Internal Standard	7.8 UE
	1,4-Dichlorobenzene		7.8 UE
	1,2-Dichlorobenzene		7.8 UE
	1,2,4-Trichlorobenzene		20 UE

Discussion: The internal standard 1,4-Dichlorobenzene-d_4 was out of criteria for Samples No. MWCS031R2 and MWCS031R2RE. The associated compounds have been flagged with "E" or "UE" for estimated.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS031R2A	Tetrachloroethene	Excessive Dilution	7.8 R
MWCS031R2A	Ethylbenzene	Excessive Dilution	7.8 R
MWCS031R2A	(m+p)-Xylene	Excessive Dilution	7.8 R
MWCS031R2A	1,3-Dichlorobenzene	Excessive Dilution	7.8 R
MWCS031R2A	1,4-Dichlorobenzene	Excessive Dilution	7.8 R
MWCS031R2A	1,2-Dichlorobenzene	Excessive Dilution	7.8 R
MWCS031R2A	1,2,4-Trichlorobenzene	Excessive Dilution	20 R

Discussion: Several samples were diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution resulting in two sets of results for one sample. To condense the results to one set of results per sample, the results that are above the calibration range, or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data for samples that are flagged with an "R" are not acceptable for use. The analyses were not within the requirements of the referenced method and significant discrepancies were observed between raw data and reported data results. However, those compounds that were flagged "R," were reanalyses of the samples. All samples still have reported values for each analyte.

For the other samples, The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Form III for the continuing calibration of May 30, 1998 on HP-3 for the acid fraction was missing from the data package. A copy was requested from the laboratory and is attached to this report.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: The dates shown on Form IV, Pages 262 and 263, are incorrect. The laboratory was requested to revise and resubmit these pages directly to Foster Wheeler. A copy of the fax and reply are attached to this report.

3. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Phenol, Benzoic Acid and Bis(2-EthylHexyl)phthalate were detected in the method blank. When using Functional Guidelines and CLP data qualifier flags, the "5 times" rule would apply. However, PSEP guidelines call for only flagging the affected compounds with a "B" to indicate presence of the compound in the blank, which the laboratory has already done.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The surrogate recovery for 2-Fluorophenol was out of criteria for Samples No. MWSC040R2A and MWCS040R4A. Per Functional Guidelines, no data flags are required unless at least two surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCSC028R2A	Benzyl Alcohol	MS/MSD, BS/BSD	26 UE
	Butylbenzylphthalate		100 UE
	Pyrene		250 E
MWCSC028R3A	Benzyl Alcohol	MS/MSD, BS/BSD	25 UE
	Butylbenzylphthalate		100 UE
	Pyrene		75 UE
MWCSC028R4A	Benzyl Alcohol	MS/MSD, BS/BSD	27 UE
	Butylbenzylphthalate		110 UE
	Pyrene		110 UE

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCSC031R2A	Benzyl Alcohol Butylbenzylphthalate Pyrene	MS/MSD, BS/BSD	3.6 E 120 UE 4900 E
MWCSC031R3A	Benzyl Alcohol Butylbenzylphthalate Pyrene	MS/MSD, BS/BSD	5.0 E 120 UE 1500 E
MWCSC031R4A	Benzyl Alcohol Butylbenzylphthalate Pyrene	MS/MSD, BS/BSD	24 UE 98 UE 100 E
MWCSC040R2A	Benzyl Alcohol Butylbenzylphthalate Pyrene	MS/MSD, BS/BSD	26 E 110 UE 910 E
MWCSC040R3A	Benzyl Alcohol Butylbenzylphthalate Pyrene	MS/MSD, BS/BSD	1.5 E 100 UE 73 E
MWCSC040R4A	Benzyl Alcohol Butylbenzylphthalate Pyrene	MS/MSD, BS/BSD	23 UE 92 UE 4.6 E

Discussion: Benzyl Alcohol, Butylbenzylphthalate, and Pyrene were within the laboratory's criteria, but out of the QAPP's criteria for accuracy with both the MS/MSD and the BS/BSD. All sample results have been flagged with "E" and "UE" for estimated.

Several analytes were out of criteria for accuracy or precision on a single MS, MSD, BS, or BSD but all other accuracy measurements (e.g., matrix spikes, surrogates and calibration verifications) are acceptable and no data qualifying flags are recommended.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

8. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS028R2A	Diethylphthalate	Mass Spectra	39 U

Discussion: On Sample No. MWCS028R2A, Diethylphthalate has a poor spectral fit and has been revised as a non-detect at the level found.

9. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Discussion: The final report listed the results for Sample No. MSWCS031R2A with a different dilution factor than the raw data. The lab provided revised chromatograms and spectra with the correct dilution factor.

10. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

11. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

12. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request a copy of the continuing calibration and revised raw data for Sample No MSWCS031R2A. This was followed up by fax notes, copies of which are appended to this validation report.

13. Other Comments

None.

14. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS031R2A	4,4'-DDT	Continuing Calibration	71 E

Discussion: Several continuing calibration checks for the RTX-CLP column had percent differences greater than the accepted criteria. All percent differences were high and all but one associated result were non-detects. On Sample No. MWCS031R2A, the laboratory reported a positive hit for the RTX-CLP column for which the associated continuing calibration value for 4,4'-DDT on both columns were flagged "E" for estimated. All continuing calibration checks on the other column were acceptable and no data qualifier flags are recommended for the non-detected results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate, Decachlorobiphenyl, on Sample No. MWCS031R2A was out of criteria on one column, but per Functional Guidelines, no data flags are required unless both surrogates are out of criteria. In addition, the surrogates on the other column were acceptable.

5. Matrix Spike/Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for a single surrogate was out of criteria for several samples, but the second surrogate was acceptable. Per both Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: The reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Discussion: The laboratory's case narrative discussed the use of manual integration. Where the reviewer was able to verify integration and baselines, the manual integration was performed appropriately.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes and duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS028R2A	Lead	Duplicate Analysis	11.0 E
MWCS028R3A	Lead	Duplicate Analysis	2.1 UE
MWCS028R4A	Lead	Duplicate Analysis	2.2 UE
MWCS031R2A	Lead	Duplicate Analysis	1020 E
MWCS031R3A	Lead	Duplicate Analysis	36.8 E
MWCS031R4A	Lead	Duplicate Analysis	2.0 UE
MWCS040R2A	Lead	Duplicate Analysis	52.1 E
MWCS040R3A	Lead	Duplicate Analysis	3.0 UE
MWCS040R4A	Lead	Duplicate Analysis	1.9 UE

Discussion: The duplicate relative percent difference for the sample duplicate analysis of Lead was out of criteria. All associated sample results have been flagged as "E" and "UE" for estimated.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Sulfide, Ammonia, TOC, and Grain Size

1. Timeliness and a Check for Error

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: There is a calculation error for the Percent Recovery for Sulfide. The correct Percent Recovery is 72%, as opposed to the 74% reported. The laboratory has been asked to correct the report and reissue the corrected page directly to Foster Wheeler, Inc.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes and matrix duplicates were analyzed as required by the referenced method, and all percent recoveries and relative percent differences were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

8. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request that the sulfide percent recovery be corrected and the revised report sent directly to Foster Wheeler Inc. This was followed up by fax notes, copies of which are appended to this report.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
304	MWCS028R2A	805036-1	8270	26	Pyrene	250	E	MS/MSD, BS/BSD
304	MWCS028R2A	805036-1	8270	8	Butylbenzylphthalate	100	UE	MS/MSD, BS/BSD
304	MWCS028R2A	805036-1	8270	14	Diethylphthalate	39	UE	Mass Spectra
304	MWCS028R2A	805036-1	6010	58	Lead	11	E	Duplicate Analysis
305	MWCS028R3A	805036-2	8270	26	Pyrene	73	E	MS/MSD, BS/BSD
305	MWCS028R3A	805036-2	8270	8	Butylbenzylphthalate	100	UE	MS/MSD, BS/BSD
305	MWCS028R3A	805036-2	6010	58	Lead	2.1	UE	Duplicate Analysis
306	MWCS028R4A	805036-3	8270	26	Pyrene	110	UE	MS/MSD, BS/BSD
306	MWCS028R4A	805036-3	8270	8	Butylbenzylphthalate	110	UE	MS/MSD, BS/BSD
306	MWCS028R4A	805036-3	6010	58	Lead	2.2	UE	Duplicate Analysis
315	MWCS031R2A	805036-4	8260	49	1,3-Dichlorobenzene	3.1	UE	Internal Standard
315	MWCS031R2A	805036-4	8260	50	1,4-Dichlorobenzene	3.1	UE	Internal Standard
315	MWCS031R2A	805036-4	8260	47	1,2-Dichlorobenzene	3.1	UE	Internal Standard
315	MWCS031R2A	805036-4	8260	38	1,2,4-Trichlorobenzene	7.8	UE	Internal Standard
315	MWCS031R2A	805036-4	8270	26	Pyrene	4900	E	MS/MSD, BS/BSD
315	MWCS031R2A	805036-4	8270	8	Butylbenzylphthalate	120	UE	MS/MSD, BS/BSD
315	MWCS031R2A	805036-4	8081	34	4,4'-DDT	71	E	Continuing Calibration
315	MWCS031R2A	805036-4	6010	58	Lead	1020	E	Duplicate Analysis
315	MWCS031R2ARE	805036-4RE	8260	40	Tetrachloroethane	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	39	Ethylbenzene	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	52	(m+p)-Xylene	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	41	o-Xylene	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	49	1,3-Dichlorobenzene	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	50	1,4-Dichlorobenzene	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	47	1,2-Dichlorobenzene	7.8	UR	Excessive Dilution
315	MWCS031R2ARE	805036-4RE	8260	38	1,2,4-Trichlorobenzene	20	UR	Excessive Dilution
317	MWCS031R3A	805036-5	8270	26	Pyrene	1500	E	MS/MSD, BS/BSD
317	MWCS031R3A	805036-5	8270	8	Butylbenzylphthalate	120	UE	MS/MSD, BS/BSD
317	MWCS031R3A	805036-5	6010	58	Lead	36.8	E	Duplicate Analysis
318	MWCS031R4A	805036-6	8270	26	Pyrene	100	E	MS/MSD, BS/BSD
318	MWCS031R4A	805036-6	8270	8	Butylbenzylphthalate	98	UE	MS/MSD, BS/BSD
318	MWCS031R4A	805036-6	6010	58	Lead	2	UE	Duplicate Analysis
335	MWCS040R2A	805036-7	8270	26	Pyrene	910	E	MS/MSD, BS/BSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
335	MWCS040R2A	805036-7	8270	8	Butylbenzylphthalate	110	UE	MS/MSD, BS/BSD
335	MWCS040R2A	805036-7	6010	58	Lead	52.1	E	Duplicate Analysis
336	MWCS040R3A	805036-8	8270	26	Pyrene	73	E	MS/MSD, BS/BSD
336	MWCS040R3A	805036-8	8270	8	Butylbenzylphthalate	100	UE	MS/MSD, BS/BSD
336	MWCS040R3A	805036-8	6010	58	Lead	3	UE	Duplicate Analysis
337	MWCS040R4A	805036-9	8270	26	Pyrene	4.6	E	MS/MSD, BS/BSD
337	MWCS040R4A	805036-9	8270	8	Butylbenzylphthalate	92	UE	MS/MSD, BS/BSD
337	MWCS040R4A	805036-9	6010	58	Lead	1.9	UE	Duplicate Analysis

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805036

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 9

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	M	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	X	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	X	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	X	M	O	O	M	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Most data qualifiers involved MS/MSD and BS/BSD failures for Pyrene, phthalates, and Lead.

DATA EVALUATION SUMMARY

SDG No. 805036

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 9

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA						4		4	4/80 =	5.0%
SVOA					19			19	19/63 =	30.2%
PEST			1					1	1/45 =	2.2%
PCB								0	0/63 =	0%
METALS					9			9	9/207 =	4.3%
INORG								0	0/63 =	0%

Note: Asterisk (*) indicates additional exceedances of review criteria. ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA							8	8	8/80 =	10.0%
SVOA								0	0/63 =	0%
PEST								0	0/45 =	0%
PCB								0	0/63 =	0%
METALS								0	0/207 =	0%
INORG								0	0/63 =	0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 12, 1998
SDG No. 805042

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWCS030R2A	805042-1	X	X	X	X	X	X	
MWCS030R3A	805042-2	X	X	X	X	X	X	
MWCS030S2A	805042-3	X	X	X	X	X	X	
MWCS027R2A	805042-4	X	X	X	X	X	X	
MWCS027R3A	805042-5	X	X	X	X	X	X	
MWCS027R4A	805042-6	X	X	X	X	X	X	

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWCS001E	805042-7	X	X	X	X	X		
MWCS026R2A	805042-8	X	X	X	X	X	X	
MWCS026R3A	805042-9	X	X	X	X	X	X	
MWCS026R4A	805042-10	X	X	X	X	X	X	
MWCS025R2A	805042-11	X	X	X	X	X	X	
MWCS025R3A	805042-12	X	X	X	X	X	X	
MWCS025R4A	805042-13	X	X	X	X	X	X	
MWC002E	805042-14	X	X	X	X	X		

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	137 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Water	97 pages	Thomas S. Davis	Lorraine L. Davis
Semivolatile Organics	Sediment	845 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	399 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	309 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Water	236 pages	Lorraine L. Davis	Thomas S. Davis
Metals	Sediment	150 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	49 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	26 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	10 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The samples were taken on May 12, 1998 and received at the laboratory with a temperature of 11.5°C on May 12. It appears that the samples were transported directly from the field to the laboratory, and may have not had sufficient time to cool to 4 ± 2°C. A Corrective Action Form was generated stating that the temperature of the samples was out of acceptance criteria of 4 ± 2°C, but there was no indication that the client was notified of the incident. The impact on the samples is negligible and no data qualifier flags are recommended.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

Sample Nos. MWCS030R2A and MWCS030S2A were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

Except as noted below, all Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: A number of target compounds had large percent differences on the continuing calibration standards for analyses that were performed after June 5, 1998. However, in this Sample Delivery Group (SDG), only a few high level target compounds were reported from diluted samples after this date. None of the target compounds that were reported after June 5, 1998 were associated with the continuing calibration compounds that had large percent differences.

The Case Narrative noted that the continuing calibration for Acenaphthene was out of criteria for diluted Sample Nos. MWCS027R4A and MWCS027R2A. The laboratory reported n-Nitrosodiphenylamine only from the diluted sample analysis and no data qualifier flags are recommended.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Bis(2-ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: One acid fraction surrogate was out of criteria in the blank spike. No data flags are recommended because the surrogates are acceptable in the samples.

The laboratory noted in the case narrative that Sample No. MWCS030R2A was reanalyzed for poor surrogate recovery. The reanalysis was within criteria and the laboratory properly reported only the reanalysis results.

Nitrobenzene-d_5 was out of criteria in the diluted analysis of four samples but the undiluted sample surrogate results were acceptable. No data qualifier flags are recommended.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS025R2A	Benzyl Alcohol	MS/MSD, BS/BSD	4.0 E
MWCS025R3A	Benzyl Alcohol	MS/MSD, BS/BSD	16 UE
MWCS025R4A	Benzyl Alcohol	MS/MSD, BS/BSD	16 UE
MWCS026R2A	Benzyl Alcohol	MS/MSD, BS/BSD	20 UE
MWCS026R4A	Benzyl Alcohol	MS/MSD, BS/BSD	18 UE
MWCS027R2A	Benzyl Alcohol	MS/MSD, BS/BSD	24 UE
MWCS027R3A	Benzyl Alcohol	MS/MSD, BS/BSD	19 UE
MWCS027R4A	Benzyl Alcohol	MS/MSD, BS/BSD	18 UE
MWCS030R2A	Benzyl Alcohol	MS/MSD, BS/BSD	2.9 E
MWCS030R3A	Benzyl Alcohol	MS/MSD, BS/BSD	1.6 E
MWCS030S2A	Benzyl Alcohol	MS/MSD, BS/BSD	2.7 E

Discussion: Benzyl Alcohol was out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pair. All associated samples have been flagged as "E" or "UE" for estimated.

A single blank spike or matrix spike for 2-Methylphenol, 4-Methylphenol, Pentacholorophenol, 2,4-Dimethylpehnol, di-n-Butylphthalate, Pyrene and Dimethylphthalate were out of criteria but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) are acceptable, and/or the percent recovery was within QAPP criteria. No data qualifier flags are recommended.

7. Field Duplicates

Sample Nos. MWCS030R2A and MWCS030S2A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS030R2A Initial Result	MWCS030S2A Duplicate Result	RPD
Phenol	75	71	5.5
Benzyl Alcohol	2.9	2.7	7.1
2-Methylphenol	22	18	20.0
4-Methylphenol	210	220	4.7
2,4-Dimethylphenol	50	60	18.2
Mean RPD, Acid Fraction			**11.1**
Standard Deviation			**7.4**
Naphthalene	4000	670	142.6
2-Methylnaphthalene	1200	220	138.0
Acenaphthylene	680	31	182.6
Acenaphthene	7200	360	181.0
Dibenzofuran	4800	280	178.0
Fluorene	12000	320	189.6
Phenanthrene	25000	600	190.6
Anthracene	4300	130	188.3
Fluoranthene	18000	390	191.5
Pyrene	12000	250	191.8
Butylbenzylphthalate	ND	4.4	NC
Benzo(a)anthracene	4500	80	193.0
Chrysene	4900	99	192.1
bis(2-Ethylhexyl)phthalate	46	23	66.7
Benzo(b)fluoranthene	4100	89	191.5
Benzo(k)fluoranthene	4100	89	191.5
Benzo(a)pyrene	2400	44	192.8
Indeno(1,2,3-cd)pyrene	1300	23	193.0
Dibenzo(a,h)anthracene	590	12	192.0
Benzo(g,h,i)perylene	1600	27	193.4
Mean RPD, B/N Fraction			**177.9**
Standard Deviation			**31.4**

Key:

ND = Not Detected NC = Not Calculable

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for the Base/Neutral analyses of Sample Nos. MWCS030R2A, MWCS025R2ARE, and MWCS027R2ARE. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(h)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request clarification on RPD calculations. This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria at several times during the analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated samples were non-detect, or all quantitation was performed from the second column which had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for Decachlorobiphenyl for Sample No. MWCS030S2A was out of criteria on one column, but per Functional Guideline and the referenced method, no data flags are required unless two surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWCS030R2A and MWCS030S2A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS030R2A Initial Result	MWCS030S2A Duplicate Result	RPD
4,4'-DDE	8.2	9.6	15.7

Key:

ND = Not Detected NC = Not Calculable

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: On the analysis of May 26, 1998, the reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Discussion: The laboratory noted that the positive hits for MWCS030R2A, MWCS030S2A and MWCS027R2A exceeded the CLP criteria of 25% difference for quantitation on two columns and has already flagged the results. These results are within the 40% difference criterion recommended by EPA Method 8000B and the laboratory has reported the higher of the two results appropriately. No additional qualifier flags are recommended.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

None.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of Polychlorinated Biphenyl Analysis by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate (Tetrachloro-m-xylene) was out of criteria for several samples, but per Functional Guidelines and the referenced method, no data flags are required unless two surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWCS030R2A and MWCS030S2A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS030R2A Initial Result	MWCS030S2A Duplicate Result	RPD
Aroclor 1260	ND	67	NC

Key:

ND = Not Detected NC = Not Calculable

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS025R2A	Aroclor 1016 and 1242	Unresolved Substances	76 C

Discussion: The reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

For Sample No. MWCS025R2A, the laboratory reported a positive hit for Aroclor 1016 and Aroclor 1242, stating that the chromatographic pattern of the two aroclors cannot be distinguished. The reviewer concurs that the hit of 76 µg/Kg is

Aroclor 1016. Chromatograms of Aroclor 1242 were requested from the lab and the reviewer also confirms that, given the labs operating conditions, that the two aroclors cannot be adequately separated and a data qualifier flag of "C" is applied, reflecting that the two mixtures cannot be resolved.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services Laboratory during the data validation process to request a fax copy of a mid-range standard for Aroclor 1242. This was followed up by fax notes, copies of which are appended to this validation report.

11. Other Comments

The laboratory should perform maintenance on the gas chromatograph used for PCB analysis so that minor, yet significant peaks could be used to distinguish Aroclor 1016 from Aroclor 1242. Alternate peaks could be used to differentiate and quantitate both PCBs.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes and duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

Associated Samples	Compound Affected	Type of Deviation	Flag
MWCS025R2A	Antimony	Matrix Spike	6.0 E
MWCS025R3A	Antimony	Matrix Spike	3.4 UG
MWCS025R4A	Antimony	Matrix Spike	3.4 UG
MWCS026R2A	Antimony	Matrix Spike	4.1 UG
MWCS026R3A	Antimony	Matrix Spike	3.7 UG
MWCS026R4A	Antimony	Matrix Spike	3.4 UG
MWCS027R2A	Antimony	Matrix Spike	467 E
MWCS027R3A	Antimony	Matrix Spike	3.6 UG
MWCS027R4A	Antimony	Matrix Spike	3.7 UG
MWCS030R2A	Antimony	Matrix Spike	4.6 UG
MWCS030R3A	Antimony	Matrix Spike	3.2 UG
MWCS030S2A	Antimony	Matrix Spike	4.2 UG

Discussion: Antimony was out of CLP and PSEP criteria, but within the laboratory's internal QC criteria for the matrix spike sample at 26.5%. All associated samples with positive results have been flagged as "E" for estimated and all non-detects have been flagged with "G" to indicate the value is greater than the minimum shown.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

Sample Nos. MWCS030R2A and MWCS030S2A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS030R2A Initial Result	MWCS030S2A Duplicate Result	RPD
Arsenic	7.4	5.6	27.7
Cadmium	0.90	0.88	2.2
Copper	95.1	88.8	6.9
Lead	62.9	68.4	8.4
Mercury	0.64	0.61	4.8
Nickel	12.5	12.5	0.0
Zinc	76.2	82.5	7.9
Mean RPD			**8.3**
Standard Deviation			**9.1**

Key:

ND = Not Detected NC = Not Calculable

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as noted below, no errors in accuracy were found.

Associated Samples	Compound Affected	Type of Deviation	Flag
MWCS027R3A	Mercury	Calculation Error	0.20

Discussion: Calculation errors were found in determining the final results from percent moisture corrections, dilutions, the amount of sample taken through preparation. The corrected value is listed in the summary table and on the laboratory final report form.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

H. Review of Inorganic Analyses

Sulfide, Ammonia, TOC, Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes and matrix duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWCS030R2A and MWCS030S2A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS030R2A Initial Result	MWCS030S2A Duplicate Result	RPD
Total Organic Carbon	32600	29600	9.6
Percent Moisture (Multichem Lab)	43	37	15.0
Total Solids (CAS Lab)	60.3	62.4	3.4
Ammonia	109	99.2	9.4
Sulfide	657	620	5.8
Mean RPD			**8.7**
Standard Deviation			**4.4**
Particle Size			
Gravel	3.6	9.4	89.2
Sand	16.1	16.4	1.8
Silt	59.7	56.0	6.4
Clay	20.6	18.3	11.8
Sum of Grain Size Distribution	100	100.1	
Mean RPD			**27.3**
Standard Deviation			**41.5**

Key:

ND = Not Detected NC = Not Calculable

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

13. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
310	MWCS030R2A	805042-1	8270	7	Benzyl Alcohol	2.9	E	MS/MSD, BS/BSD
310	MWCS030R2A	805042-1	6010	54	Antimony	4.6	UG	Matrix Spike
297	MWCS026R4A	805042-10	8270	7	Benzyl Alcohol	18	E	MS/MSD, BS/BSD
297	MWCS026R4A	805042-10	6010	54	Antimony	3.4	UG	Matrix Spike
288	MWCS025R2A	805042-11	8270	7	Benzyl Alcohol	4.0	E	MS/MSD, BS/BSD
288	MWCS025R2A	805042-11	8082	88	Aroclor 1016	76	C	Unresolved Substances
288	MWCS025R2A	805042-11	6010	54	Antimony	6	E	Matrix Spike
289	MWCS025R3A	805042-12	8270	7	Benzyl Alcohol	16	E	MS/MSD, BS/BSD
289	MWCS025R3A	805042-12	6010	54	Antimony	3.4	UG	Matrix Spike
290	MWCS025R4A	805042-13	8270	7	Benzyl Alcohol	16	E	MS/MSD, BS/BSD
290	MWCS025R4A	805042-13	6010	54	Antimony	3.4	UG	Matrix Spike
311	MWCS030R3A	805042-2	8270	7	Benzyl Alcohol	1.6	E	MS/MSD, BS/BSD
311	MWCS030R3A	805042-2	6010	54	Antimony	3.2	UG	Matrix Spike
312	MWCS030S2A	805042-3	8270	7	Benzyl Alcohol	2.7	E	MS/MSD, BS/BSD
312	MWCS030S2A	805042-3	6010	54	Antimony	4.2	UG	Matrix Spike
300	MWCS027R2A	805042-4	8270	7	Benzyl Alcohol	24	E	MS/MSD, BS/BSD
300	MWCS027R2A	805042-4	6010	54	Antimony	467	E	Matrix Spike
301	MWCS027R3A	805042-5	8270	7	Benzyl Alcohol	19	E	MS/MSD, BS/BSD
301	MWCS027R3A	805042-5	6010	54	Antimony	3.6	UG	Matrix Spike
301	MWCS027R3A	805042-5	7471	59	Mercury	0.2		Calculation Error
302	MWCS027R4A	805042-6	8270	7	Benzyl Alcohol	18	E	MS/MSD, BS/BSD
302	MWCS027R4A	805042-6	6010	54	Antimony	3.7	UG	Matrix Spike
296	MWCS026R3A	805042-7	6010	54	Antimony	3.7	UG	Matrix Spike
295	MWCS026R2A	805042-8	8270	7	Benzyl Alcohol	20	E	MS/MSD, BS/BSD
295	MWCS026R2A	805042-8	6010	54	Antimony	4.1	UG	Matrix Spike

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805042

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 14

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	X	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	X	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	X	O	O	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Most data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol and Antimony. One PCB result was flagged for having an unresolved substance present.

DATA EVALUATION SUMMARY

SDG No. 805042

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 14

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA								0	0/112 = 0%
SVOA					11			11	11/220 = 5.0%
PEST								0	0/70 = 0%
PCB					1			1	1/98 = 1.0%
METALS					12		1**	13	13/322 = 4.0%
INORG								0	0/98 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standard	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/112 = 13%
SVOA								0	0/220 = 0%
PEST								0	0/70 = 0%
PCB								0	0/98 = 0%
METALS								0	0/322 = 0%
INORG								0	0/98 = 0%

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 15, 1998
SDG No. 805047

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

10/14/98

Thomas S. Davis, Principal — Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 2 Data Qualification Summary
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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWCS037R2A	805047-1	X	X	X	X	X	X	
MWCS037R3A	805047-2	X	X	X	X	X		
MWCS037R4A	805047-3	X	X	X	X	X	X	
MWCS024R2A	805047-4	X	X	X	X	X	X	
MWCS024R3A	805047-5	X	X	X	X	X	X	
MWCS003E	805047-6	X	X	X	X	X		

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	77 pages	Debbie Copsey	Lorraine L Davis
Semivolatile Organics	Water	89 pages	Thomas S. Davis	Lorraine L Davis
Semivolatile Organics	Sediment	499 pages	Thomas S. Davis	Lorraine L Davis
Pesticides	Sediment	346 pages	Thomas S. Davis	Lorraine L Davis
PCBs	Sediment	261 pages	Thomas S. Davis	Lorraine L Davis
Metals	Water	231 pages	Lorraine L. Davis	Thomas S. Davis
Metals	Sediment	150 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Water and Sediment	50 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	23 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	6 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The samples were taken from May 11 to May 13, 1998 and were sent to MultiChem Analytical Services with a chain-of-custody marked "Hold". The times relinquished and received do not match by five minutes (May 12 at 1745 vs. May 12 at 1750). Foster Wheeler has stated that this is due to differences in personal watches and clocks, and the time taken to complete the laboratory's paperwork, and that the samples were proper custody during this time. These samples were received back by Mark Otten of Foster Wheeler on May 13, 1998 at 0950 from the laboratory, which did not sign the form to relinquish the samples.

A second set of custody forms lists these samples as being received at the laboratory a second time with a temperature of 13.3°C on May 13 at 1430. A Corrective Action Form was generated stating that the temperature of the samples was out of the acceptance criteria of 4 ± 2°C, but there was no supervisory review/signature on the form, nor is there any indication that the client was notified of the incident. Foster Wheeler has investigated this issue and has stated that the elevated temperature was due to subsampling and sample splitting on May 13, and that the samples had not had time to chill prior to the laboratory receiving them. It is the reviewer's opinion that the impact on the samples of the temperature exceedence is negligible and no data qualifier flags are recommended

Sample No. MWCS025R3A was received with the samples that were logged into the laboratory as Sample Delivery Group (SDG) No. 805042 but was reported with this SDG. All QC associated with this sample was reviewed and any comments regarding this sample are included in this report.

C. Review of GC/MS Volatiles Analyses
EPA Method 8270B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

D. Review of GC/MS Semi-Volatiles Analyses
EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid and Bis(2-ethylhexyl)phthalate were detected in the method blank. When using Functional Guidelines and CLP data qualifier flags, the "5 times" rule would apply. However, PSEP guidelines call for only flagging the affected compounds with a "B" to indicate presence of the compound in the blank, which the laboratory has done appropriately.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria

Discussion: The percent recovery for Dimethylphthalate was out of criteria for the blank spike/blank spike duplicate (BS/BSD). Since all other measurements (e.g., matrix spikes, surrogates and calibration verifications) are acceptable and no data qualifier flags are recommended.

Several analytes were out of criteria for accuracy or precision on one of matrix spikes, matrix spike duplicates, blank spike or blank spike duplicate but all other accuracy measurements (e.g., matrix spikes, surrogates and calibration verifications) are acceptable and no data qualifying flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS037R3A	Chrysene	Mass Spectra	3.8 U

Discussion: On Sample No. MWCS037R3A, Chrysene has a poor spectral fit and has been revised as a non-detect.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services on August 4, 1998 during the data validation process to request a copy of the continuing calibration. This was followed up by fax notes, copies of which are attached to this validation report. The telephone call also included a discussion of apparent errors in the calculation of RPD the Form IIIs for MS/MSD and BS/BSD. In discussion, it was found that the lab was calculating the values correctly.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, is acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RSD) greater than that allowed by the method.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS024R2A	4,4'-DDE	Continuing Calibration	11 E

Discussion: A continuing calibration check for the Target Compound List (TCL) 4,4'-DDE for Sample No. MWCS024R2A had percent differences greater than the acceptance criteria on both columns and the associated results have been flagged with a "E" for estimated. In Section 8 of this report, this value was revised due to a calculation error.

3. Blanks and Checks for Calibration

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for one surrogate on one column for several samples were out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: On the analysis of May 26, 1998, the reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS024R2A	4,4'-DDE	Calculation Error	11 E

Discussion: On the positive hits for MWCS024R2A for 4,4'-DDE, the percent difference between the primary and confirmatory columns was greater than 40% and the lab reported the lower of the two values. In accordance with EPA Method 8000B, Section 7.10.4.2, the report is revised to use the higher value. In Section 2 of this report, the results have already been flagged "E" for estimated.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, is acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Calibration

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate on one column for several samples were out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: The reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes and duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

Associated Samples	Compound Affected	Type of Deviation	Flag
MWCS037R2A	Antimony	Matrix Spike	3.5 UG
MWCS037R3A	Antimony	Matrix Spike	3.4 UG
MWCS037R4A	Antimony	Matrix Spike	3.7 UG
MWCS024R2A	Antimony	Matrix Spike	4.0 UG
MWCS024R3A	Antimony	Matrix Spike	3.6 UG

Discussion: Antimony was out of CLP and PSEP criteria, but within the laboratory's internal QC criteria for the matrix spike sample at 26.5%. All non-detects have been flagged with "G" to indicate the reporting limit is greater than the minimum shown.

Lead was out of criteria for precision n the duplicate sample analysis. The original result was less than five-times the reporting limit and the duplicate result was slightly greater than five-times the reporting limit. The laboratory has already flagged these results and no additional data qualifier flags are recommended.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted five-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

I. Review of Inorganic Analyses

Sulfide, Ammonia, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: There is a calculation error for the Percent Recovery for Sulfide. The correct Percent Recovery is 72%, as opposed to the 74% reported. The laboratory has been asked to correct the report and reissue the corrected page directly to Foster Wheeler, Inc.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes and matrix duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

8. Laboratory Contact

Kim Lofgren at MultiChem Analytical Services was requested to reissue a corrected matrix spike recovery report for Sulfide directly to Foster Wheeler. This was followed up by fax notes, copies of which are attached to this validation report.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
327	MWCS037R2A	805047-1	6010	54	Antimony	3.5	UG	Matrix Spike
328	MWCS037R3A	805047-2	8270	9	Chrysene	3.8	U	Mass Spectra
328	MWCS037R3A	805047-2	6010	54	Antimony	3.4	UG	Matrix Spike
329	MWCS037R4A	805047-3	6010	54	Antimony	3.7	UG	Matrix Spike
284	MWCS024R2A	805047-4	8081	33	4,4'-DDE	11	E	Continuing Calibration, Calculation Error
284	MWCS024R2A	805047-4	6010	54	Antimony	4	UG	Matrix Spike
285	MWCS024R3A	805047-5	6010	54	Antimony	3.6	UG	Matrix Spike

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805047

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 6

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	O	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	O	O	O	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Most data qualifiers involved MS/MSD and BS/BSD failures for Antimony. One result for Chrysene and one result for 4,4'-DDE were revised due to spectral interpretation and a calculation error, respectively.

DATA EVALUATION SUMMARY

SDG No. 805047

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 6

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA								0	0/48 =	0%
SVOA							1	1	1/103 =	0.9%
PEST			1					1	1/30 =	3.3%
PCB								0	0/42 =	0%
METALS					5			5	5/138 =	3.6%
INORG								0	0/28 =	0%

Note: Asterisk (*) indicates additional exceedances of review criteria. ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA								0	0/48 =	0%
SVOA								0	0/103 =	0%
PEST								0	0/30 =	0%
PCB								0	0/42 =	0%
METALS								0	0/138 =	0%
INORG								0	0/28 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria

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Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 12, 1998
SDG No. 805052

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
Attachment 3 Data Evaluation Summary
Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, as revised, 1994; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWSS035R1	805052-1	X	X	X	X	X	X	
MWSS029R1	805052-2	X	X	X	X	X	X	
MWSS030R1	805052-3	X	X	X	X	X	X	
MWSS031R1	805052-4	X	X	X	X	X	X	
MWSS028R1	805052-5	X	X	X	X	X	X	
MWSS040R1	805052-6	X	X	X	X	X	X	
MWSS034R1	805052-7	X	X	X	X	X		

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	137 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	735 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	479 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	303 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	255 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	65 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	31 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	8 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: There is a break in chain-of-custody for samples marked for TBT. MultiChem Analytical Services relinquished the samples on May 14, 1998 at 0700 and the samples were received by Steven R. Hoffman at Columbia Analytical Services on May 14, 1998 at 0857.

Foster Wheeler has investigated this issue and the sample shipping codes are on file with MultiChem and Federal Express. No further action is required.

Columbia Analytical Services, Inc. received two bottles with no identification tags and did not receive a sample bottle for ammonia for Sample No. MWSS034R1. The laboratory noted the anomalies on a Cooler Receipt and Preservation Form but does not indicate there was a resolution to the anomalies.

Foster Wheeler reports that the two bottles were disposed of at Columbia Analytical and a replacement bottle was shipped from MultiChem to Columbia Analytical with the appropriate documentation. No further action is required.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS034R1	Tetrachloroethene	Holding time	3.6 UE
	Ethylbenzene		3.6 UE
	m-,p-Xylene		3.6 UE
	o-Xylene		3.6 UE
	1,3-Dichlorobenzene		3.6 UE
	1,4-Dichlorobenzene		3.6 UE
	1,2-Dichlorobenzene		3.6 UE
	1,2,4-Trichlorobenzene		9.1 UE

Discussion: The analysis of Sample No. MWSS034R1 exceeded the holding time by five days. All associated results have been flagged with "E" or "UE" for estimated.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no written or verbal contact with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

D. Review of GC/MS Semi-Volatiles Analyses
Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

Except as noted below, all Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis. All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

Discussion: The matrix spike duplicate that was performed on Sample No. MWSS034R1 was analyzed ten minutes after the 12 hour tuning clock had expired. This is a quality control check sample and it is the reviewer's judgment that a data qualifier flag is not warranted.

3. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration quality control criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RSD) greater than that allowed by the method and all System Performance Check Compounds (CCC) criteria were met.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS034R1	Benzyl Alcohol	Continuing Calibration	8.4 E
MWSS029R1	Indeno(1,2,3-cd) pyrene	Continuing Calibration	350 E
MWSS029R1	Dibenzo(a, h)anthracene	Continuing Calibration	33 UE
MWSS029R1	Benzo(g, h, i)perylene	Continuing Calibration	360 E
MWSS030R1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	300 E
MWSS030R1	Dibenzo(a, h)anthracene	Continuing Calibration	35 UE

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS030R1	Benzo(g, h, i)perylene	Continuing Calibration	290 E
MWSS028R1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	240 E
MWSS028R1	Dibenzo(a, h)anthracene	Continuing Calibration	64 E
MWSS028R1	Benzo(g, h, i)perylene	Continuing Calibration	250 E
MWSS034R1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	270 E
MWSS034R1	Dibenzo(a, h)anthracene	Continuing Calibration	61 E
MWSS034R1	Benzo(g, h, i)perylene	Continuing Calibration	270 E

Discussion: The continuing calibration checks for Benzyl Alcohol, which was associated with Sample No. MWSS034R1 and Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene and Benzo(g,h,i)perylene associated with Sample Nos. MWSS029R1, MWSS030R1, MWSS028R1 and MWSS034R1 had percent differences greater than the acceptance criteria and the associated results have been flagged with a "E" or "UE" for estimated.

Several continuing calibration checks were out of criteria at several times during the analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated samples were non-detect, or all quantitation was performed from the second column which had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Bis(2-Ethylhexyl)phthalate was detected in a method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate was out of criteria on one column for several samples, but per Functional Guidelines, no data flags are required unless

both surrogates are out of criteria. In addition, the surrogates on the other column were acceptable.

The case narrative discussed the use of a secondary ion to quantitate Nitrobenzene-d_5. The reviewer concurs that this quantitation was performed appropriately.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS035R1	Benzyl Alcohol	MS/MSD & BS/BSD	4.3 E
MWSS029R1	Benzyl Alcohol	MS/MSD & BS/BSD	7.9 E
MWSS030R1	Benzyl Alcohol	MS/MSD & BS/BSD	7.5 E
MWSS031R1	Benzyl Alcohol	MS/MSD & BS/BSD	3.8 E
MWSS028R1	Benzyl Alcohol	MS/MSD & BS/BSD	2.0 E
MWSS034R1	Benzyl Alcohol	MS/MSD & BS/BSD	8.4 E
MWSS034R1	2,4-Dimethylphenol	MS/MSD & BS/BSD	7.4 E
MWSS034R1	Phenol	MS/MSD	620 E
MWSS034R1	Naphthalene	MS/MSD	290 E
MWSS034R1	Phenanthrene	MS/MSD	1200 E
MWSS034R1	Fluoranthene	MS/MSD	1500 E
MWSS034R1	Pyrene	MS/MSD	1700 E
MWSS034R1	Benzo(a)anthracene	MS/MSD	750 E
MWSS034R1	Chrysene	MS/MSD	800 E
MWSS034R1	bis(2-Ethylhexyl)phthalate	MS/MSD	500 E
MWSS034R1	Benzo(a)pyrene	MS/MSD	720 E
MWSS034R1	Benzo(g,h,i)perylene	MS/MSD	270 E

Discussion: Benzyl Alcohol and 2,4-Dimethylphenol were out of criteria for both accuracy (percent recovery) and precision (%RPD) for both the MS/MSD and BS/BSD pair. All samples from the May 18 and June 3 extraction batches have been flagged as "E" or "UE" for estimated for Benzyl Alcohol. One sample extracted on June 3 have been flagged "E" for estimated for 2,4-Dimethylphenol.

Phenol, Naphthalene, Phenanthrene, Fluoranthene, Pyrene, Crysene, bis(2-Ethylhexyl)phthalate, Benzo(a)anthracene, Benzo(a)pyrene and Benzo(g,h,i)

perylene was out of criteria for both accuracy (percent recovery) and precision (%RPD) for the MS/MSD pair that was done on June 3. Only the results for these compounds spiked in Sample No. MWSS034R1 have been flagged with a "E" or "UE" for estimated because all other quality control measurements (surrogates, BS/BSD) were acceptable.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

Discussion: The laboratory noted in their Case Narrative that the internal standards were out of criteria for the Base/Neutral analyses of Sample Nos. MWSS029R1, MWSS031R1 and MWSS034R1RE. The reviewer concurs that the corrective action was appropriate, and no data qualifier flags are recommended.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(h)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticides by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria at several times during the analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated samples were non-detect, or all quantitation was performed from the second column which had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicate

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: On the analyses of May 18, 1998 and June 5, 1998, the reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS029R1	4,4'-DDT	Calculation Error	30 E
MWSS031R1	4,4'-DDE	Calculation Error	93 E

Discussion: The laboratory noted that the positive hits for MWSS029R1 for 4,4'-DDT and MWSS031R1 for 4,4'-DDT, the percent recovery was greater than 40% and the lab reported the higher of the two values. In accordance with EPA method 8000B, Section 7.10.4.2, the report is revised to use the higher value. In section 2 of this report, the results have already been flagged "E" for estimated.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

F. Review of PCBs by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicate

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: There were analyst notations on the raw data that were not initialed and dated.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes and duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

Associated Samples	Compound Affected	Type of Deviation	Flag
MWSS028R1	Antimony	Matrix Spike	3.7 UG
MWSS029R1	Antimony	Matrix Spike	6.1 G
MWSS030R1	Antimony	Matrix Spike	5.8 UG
MWSS031R1	Antimony	Matrix Spike	6.8 UG
MWSS034R1	Antimony	Matrix Spike	4.6 UG
MWSS035R1	Antimony	Matrix Spike	5.0 UG

Discussion: Antimony was out of CLP and PSEP criteria, but within the laboratory's internal QC criteria for the matrix spike sample at 26.5%. All associated samples with positive results have been flagged as "E" for estimated and all non-detects have been flagged with "G" to indicate the value is greater than the minimum shown.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted five-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Sulfide, Ammonia, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as noted below, no errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
325	MWSS035R1	805052-1	8270	7	Benzyl Alcohol	4.3	E	MS/MSD & BS/BSD
325	MWSS035R1	805052-1	6010	54	Antimony	5	UG	Matrix Spike
309	MWSS029R1	805052-2	8270	18	Indeno(1,2,3-cd)pyrene	350	E	Continuing Calibration
309	MWSS029R1	805052-2	8270	12	Dibenzo(a,h)anthracene	33	E	Continuing Calibration
309	MWSS029R1	805052-2	8270	4	Benzo(g,h,i)perylene	360	E	Continuing Calibration
309	MWSS029R1	805052-2	8270	7	Benzyl Alcohol	7.9	E	MS/MSD & BS/BSD
309	MWSS029R1	805052-2	8081	34	4,4'-DDT	30		Calculation Error
309	MWSS029R1	805052-2	6010	54	Antimony	6.1	G	Matrix Spike
313	MWSS030R1	805052-3	6010	54	Antimony	5.8	UG	Matrix Spike
313	MWSS030R1	805052-3	8270	18	Indeno(1,2,3-cd)pyrene	300	E	Continuing Calibration
313	MWSS030R1	805052-3	8270	12	Dibenzo(a,h)anthracene	35	E	Continuing Calibration
313	MWSS030R1	805052-3	8270	4	Benzo(g,h,i)perylene	290	E	Continuing Calibration
313	MWSS030R1	805052-3	8270	7	Benzyl Alcohol	7.5	E	MS/MSD & BS/BSD
319	MWSS031R1	805052-4	8270	7	Benzyl Alcohol	3.8	E	MS/MSD & BS/BSD
319	MWSS031R1	805052-4	8081	33	4,4'-DDE	93		Calculation Error
319	MWSS031R1	805052-4	6010	54	Antimony	6.8	UG	Matrix Spike
307	MWSS028R1	805052-5	8270	18	Indeno(1,2,3-cd)pyrene	240	E	Continuing Calibration
307	MWSS028R1	805052-5	8270	12	Dibenzo(a,h)anthracene	64	E	Continuing Calibration
307	MWSS028R1	805052-5	8270	4	Benzo(g,h,i)perylene	250	E	Continuing Calibration
307	MWSS028R1	805052-5	8270	7	Benzyl Alcohol	2.0	E	MS/MSD & BS/BSD
307	MWSS028R1	805052-5	6010	54	Antimony	3.7	UG	Matrix Spike
323	MWSS034R1	805052-7	8270	71	2-Methylnaphthalene	290	E	MS/MSD
323	MWSS034R1	805052-7	8270	23	Phenanthrene	1200	E	MS/MSD
323	MWSS034R1	805052-7	8270	16	Fluoranthene	1500	E	MS/MSD
323	MWSS034R1	805052-7	8270	26	Pyrene	1700	E	MS/MSD
323	MWSS034R1	805052-7	8270	1	Benzo(a)anthracene	750	E	MS/MSD
323	MWSS034R1	805052-7	8270	9	Chrysene	800	E	MS/MSD
323	MWSS034R1	805052-7	8270	28	bis(2-Ethylhexyl)phthalate	500	E	MS/MSD
323	MWSS034R1	805052-7	8270	2	Benzo(a)pyrene	720	E	MS/MSD
323	MWSS034R1	805052-7	8270	18	Indeno(1,2,3-cd)pyrene	270	E	Continuing Calibration
323	MWSS034R1	805052-7	8270	12	Dibenzo(a,h)anthracene	61	E	Continuing Calibration
323	MWSS034R1	805052-7	8270	4	Benzo(g,h,i)perylene	270	E	Continuing Calibration
323	MWSS034R1	805052-7	8270	24	Phenol	620	E	MS/MSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
323	MWSS034R1	805052-7	8270	7	Benzyl Alcohol	8.4	E	MS/MSD & BS/BSD
323	MWSS034R1	805052-7	8270	68	2,4-Dimethylphenol	7.4	E	MS/MSD & BS/BSD
323	MWSS034R1	805052-7	8260	40	Tetracholoroethene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	39	Ethylbenzene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	53	m,p-Xylene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	41	o-Xylene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	49	1,3-Dichlorobenzene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	50	1,4-Dichlorobenzene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	47	1,2-Dichlorobenzene	3.6	UE	Holding Time
323	MWSS034R1	805052-7	8260	38	1,2,4-Trichlorobenzene	9.1	UE	Holding Time
323	MWSS034R1	805052-7	6010	54	Antimony	4.6	UG	Matrix Spike

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805052

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 7

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	M	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	M	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	M	M	O	O	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for PAHs on 1 sample and for Benzyl Alcohol and Antimony on several samples, plus holding times for a single VOC sample. Two results were changed for calculation errors.

DATA EVALUATION SUMMARY

SDG No. 805052

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 7

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA		8						8	8/56 = 14.3%
SVOA			12		16			28	28/49 = 57.1%
PEST							2**	2	2/35 = 5.7%
PCB								0	0/49 = 0%
METALS					6			6	6/161 = 3.7%
INORG								0	0/42 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria. ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standard	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/56 = 0%
SVOA								0	0/49 = 0%
PEST								0	0/35 = 0%
PCB								0	0/49 = 0%
METALS								0	0/161 = 0%
INORG								0	0/42 = 0%

Quality By Design

Laboratory Quality Assurance Consulting

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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 12, 1998
SDG No. 805056

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 2 Data Qualification Summary
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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer, and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWCS035R2A	805056-1	X	X	X	X	X	X	
MWCS035R3A	805056-2	X	X	X	X	X	X	
MWCS035R4A	805056-3	X	X	X	X	X	X	
MWCS035S4A	805056-4	X	X	X	X	X	X	
MWCS029R2A	805056-5	X	X	X	X	X	X	
MWCS029R3A	805056-6	X	X	X	X	X	X	
MWCS029R4A	805056-7	X	X	X	X	X	X	
MWCS034R2A	805056-8	X	X	X	X	X	X	
MWCS034R3A	805056-9	X	X	X	X	X	X	
MWCS034R4A	805056-10	X	X	X	X	X	X	
MWCS004E	805056-11	X	X	X	X	X	X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	113 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Water	96 pages	Thomas S. Davis	Lorraine L. Davis
Semivolatile Organics	Sediment	528 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	320 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	281 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Water	233 pages	Lorraine L. Davis	Thomas S. Davis
Metals	Sediment	235 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	48 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	23 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	13 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The samples were taken on May 12, 1998, then subsampled, and received at the laboratory with a temperature of 8.7°C on May 14. The elevated temperature was due to the subsampling process and the samples had not had sufficient chill time before submittal to the laboratory. The impact on the samples is negligible and no data qualifier flags are recommended.

The chain-of-custody shows MultiChem Analytical Services receiving the samples on May 14, 1998 at 1440, but the chain-of-custody notes that they were relinquished at 1500 by a Foster Wheeler Environmental Consultants representative. Foster Wheeler has investigated this anomaly and has stated that the samples were in the proper custody of Foster Wheeler staff during these times, and that the time difference was due to slight differences in personal clocks and watches, and to the time taken to complete paperwork at the laboratory.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Calculations for the Response Factor (RF) and Percent Difference (%D) were incorrect for the Continuing Calibration Check analyzed on May 20, 1998 at 0934 on HP2 (Page 74 of the SDG data package). The reviewer was able to recalculate the response factor and the percent difference, and all results were within criteria. No data qualifier flags are recommended.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

Sample Nos. MWCS035R4A and MWCS035S4A were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request that the MS/MSD report sheet for MWCS028 R2A be revised and reissued. This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatile Analyses
EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

Except as noted below, all Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MSWS034R4A	Phenol	DFTPP Tuning	5.9 E
	Benzyl Alcohol		18 UE
	2-Methyphenol		32 UE
	4-Methylphenol		1.1 E
	2,4-Dimethylphenol		18 UE
	Benzoic Acid		20 E
	Pentachlorophenol		46 UE

Discussion: The instrument was not tuned at the proper frequency with DFTPP on June 3, 1998 and all analytes in the acid fraction in Sample No. MWCS034R4A have been flagged with "E" and "UE" for estimated.

A typographical error was noted for m/e 70 on Form V (Page 66) of the acid fraction and a revised page has been requested from the laboratory. A copy of the revision is attached to this report.

3. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Pentachlorophenol, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene had percent differences greater than 30%, however the method has no acceptance criteria defined for these compounds. In addition, the laboratory has already flagged all positive results with "J" and no additional data qualifier flags are recommended.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Bis(2-Ethylhexyl)phthalate, Phenol, and Benzoic Acid were detected in the method blanks analyzed with this SDG. The concentration of each compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Surrogates were out of criteria in the blank associated with the data. No data flags are recommended because the surrogates are acceptable in the samples.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS029R2A	Benzyl Alcohol	MS/MSD	18 UE

Discussion: Benzyl Alcohol was out of criteria for accuracy in both the Matrix Spike and Matrix Spike Duplicate. Only the results of this compound in the sample spiked has been flagged with "UE" for estimated because all other quality control checks (e.g., blank spike, blank spike duplicate, and surrogates) were acceptable.

For several other analytes, a single blank spike or matrix spike was out of criteria but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) are acceptable, and/or the percent recovery was within QAPP criteria. No data qualifier flags are recommended.

7. Field Duplicates

Sample Nos. MWCS035R4A and MWCS035S4A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	**MWCS035R4A Initial Result**	**MWCS035S4A Duplicate Result**	**RPD**
Phenol	5.8	3.3	54.9
2-Methylphenol	0.97	0.90	7.5
Benzoic Acid	22	23	4.4
Pentachlorophenol	ND	45	NC
Mean RPD, Acid Fraction			**22.3**
Standard Deviation			**28.3**
2-Methylnaphthalene	ND	7.0	NC
Phenanthrene	14	12	15.4
bis(2-Ethylhexyl)phthalate	40	20	66.7
Benzo(a)pyrene	220	200	9.5
Mean RPD, B/N Fraction			**30.5**
Standard Deviation of the Mean RPD			**31.4**

Key: ND = Not Detected NC = Not Calculable

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS035R2A	Benzyl Alcohol	Retention Time	1.8 U
MWCS035R4A	2-Methylphenol	Retention Time	0.97 U

Discussion: On Sample No. MWCS035R2A, Benzyl Alcohol was identified as present by the laboratory. However, the retention time is not acceptable and this result has been revised to non-detect.

On Sample No. MWCS035R4A, 2-Methylphenol was identified as present by the laboratory. However, the retention time is not acceptable and this result has been revised to non-detect.

The laboratory noted that Benzo(b)fluoranthene and Benzo(k)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services on August 4, 1998 to discuss apparent calculation errors on the B/N fraction MS/MSD RPD results. In discussion, it was found that the lab was calculating the values correctly. This was followed up by a fax not, a copy of which are appended to this validation report. The lab also reissued a revised Form 5 for DFTPP for June 2, 1998.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticides by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl was out of criteria for Sample No. MWCS035R3A, but per Functional Guidelines and the referenced method, no data flags are required unless two surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWCS035R4A and MWCS035S4A were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: On the analysis of May 18, 1998, the reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method. including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCBs by Gas Chromatography
EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Tetrachloro-m-xylene was out of criteria on Sample No. MWCS029R2A, but per Functional Guidelines and the referenced method, no data flags are required unless two surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWCS035R4A and MWCS035S4A were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: On the analysis of May 18, 1998, the reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Discussion: The laboratory noted trace results that were less than their reporting limit but above their detection limit and have already flagged these values appropriately with "J" for estimated.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes and duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

Discussion: A single matrix spike for arsenic and lead was out of criteria but all other accuracy measurements (e.g., matrix spikes and calibration verifications) are acceptable and no data qualifying flags are recommended.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

Sample Nos. MWCS035R4A and MWCS035S4A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS035R4A Initial Result	MWCS035S4A Duplicate Result	RPD
Arsenic	1.4	1.2	15.4
Copper	18.6	18.5	0.5
Lead	2.4	3.1	25.5
Nickel	9.2	9.1	1.1

Analyte	MWCS035R4A Initial Result	MWCS035S4A Duplicate Result	RPD
Zinc	20.4	20.1	1.5
Mean RPD			**8.8**
Standard Deviation			**11.2**

Key:
ND = Not Detected NC = Not Calculable

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as noted below, no errors in accuracy were found.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

There were changes in the raw data regarding sample identification. There are no analyst initials and dates associated with the changes.

The QC pages contain results for Aluminum, Calcium, Magnesium, and Iron. These results are not applicable to the project data presented in the package

13. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Error

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes and matrix duplicates were analyzed as required by the referenced method and except as noted below, all percent recoveries and relative percent differences were within laboratory or method criteria.

Discussion: There was a calculation error in the percent recovery for the Sulfide matrix spike. The correct value should be 72% and not the 74% as reported by the laboratory. The correction has been made directly on the report sheet by the reviewer. The lab was notified and has provided a revised report.

6. Field Duplicates

Sample Nos. MWCS035R4A and MWCS035S4A were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWCS035R4A Initial Result	MWCS035S4A Duplicate Result	RPD
Total Organic Carbon	5750	5750	0.0
Percent Moisture (Multichem Lab)	27	25	7.7
Ammonia	24.2	23.5	2.9
Sulfide	46.2	69.4	40.1
Mean RPD			**12.7**
Standard Deviation			**18.6**
Particle Size			
Gravel	0	0	0
Sand	47.1	39.2	18.3
Silt	48.1	55.4	14.1
Clay	4.8	5.4	11.8
Sum of Grain Size Distribution	100	100	
Mean RPD			**14.7**
Standard Deviation			**3.3**

Key:
ND = Not Detected NC = Not Calculable

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

8. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request the percent recovery for sulfide be corrected. The laboratory has submitted a revised page, a copy of which is attached.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
392	MWCS035R2A	805056-1	8270	7	Benzyl Alcohol	1.8	E	MS/MSD & BS/BSD
386	MWCS029R2A	805056-5	8270	7	Benzyl Alcohol	18	E	MS/MSD & BS/BSD
394	MWCS035R4A	805056-3	8270	7	Benzyl Alcohol	18	E	MS/MSD & BS/BSD

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805056

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 11

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	X	O	O	O	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	X	O	O	O	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for three samples for Benzyl Alcohol.

DATA EVALUATION SUMMARY

SDG No. 805056

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 11

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA								0	0/88 = 0%
SVOA					3			3	3/138 = 2.2%
PEST								0	0/55 = 0%
PCB								0	0/77 = 0%
METALS								0	0/253 = 0%
INORG								0	0/77 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/88 = 0%
SVOA								0	0/138 = 0%
PEST								0	0/55 = 0%
PCB								0	0/77 = 0%
METALS								0	0/253 = 0%
INORG								0	0/77 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 14, 1998
SDG No. 805058

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, as revised, December, 1994; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer, and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWSS016R1	805058-1	X	X	X	X	X	X	
MWSS017R1	805058-2	X	X	X	X	X	X	
MWSS021R1	805058-3	X	X	X	X	X	X	
MWSS018R1	805058-4	X	X	X	X	X	X	
MWSS019R1	805058-5	X	X	X	X	X	X	
MWSS020R1	805058-6	X	X	X	X	X	X	
MWSS027R1	805058-7	X	X	X	X	X	X	
MWSS032R1	805058-8	X	X	X	X	X	X	
MWSS023R1	805058-9	X	X	X	X	X	X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	141 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	737 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	518 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	295 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	165 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	59 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	23 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	17 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors were found.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS021R1	1,3-Dichlorobenzene	Internal Standard	4.2 UE
	1,4-Dichlorobenzene		4.2 UE
	1,2-Dichlorobenzene		4.2 UE
	1,2,4-Trichlorobenzene		10 UE
MWSS021R1RE	1,3-Dichlorobenzene	Internal Standard	8.3 UE
	1,4-Dichlorobenzene		8.3 UE
	1,2-Dichlorobenzene		8.3 UE
	1,2,4-Trichlorobenzene		21 UE

Discussion: The internal standard 1,4-Dichlorobenzene-d_4 was out of criteria for Sample Nos. MWSS021R1 and MWSS021R1RE. The associated compounds have been flagged with "E" or "UE" for estimated.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS021R1RE	All	Excessive Dilution	R

Discussion: Sample No. MWSS021RE was diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution. To condense the results to one result per analyte per sample, the results that are above the calibration range or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

All TIC calculations, spectra, and library searches were reviewed and met the criteria of the referenced method. In Sample Nos. MWSS021R1 and MWSS021R1RE tentatively identified compounds were reported. The laboratory has already flagged the results with "NJ" for tentatively identified with estimated concentrations.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data for samples that are flagged with an "R" are not acceptable for use. The analyses were not within the requirements of the referenced method and significant discrepancies were observed between raw data and reported data results. However, those compounds that were flagged "R," were reanalyses of the samples. All samples still have reported values for each analyte.

For the other samples, the data, as qualified, is acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semi-Volatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS020R1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	30 E
	Dibenzo(a,h)anthracene		31 UE
	Benzo(g,h,i)perylene		36 E
MWSS027R1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	370 E
	Dibenzo(a,h)anthracene		160 E
	Benzo(g,h,i)perylene		380 E
MWSS032R1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	460 E
	Dibenzo(a,h)anthracene		210 E
	Benzo(g,h,i)perylene		460 E

Discussion: A continuing calibration check for Indeno(1,2,3-cd)pyrene, Benzo(g,h,i)perylene, and Dibenzo(a,h)anthracene had percent differences greater than 50%. Although there are no method or QAPP requirements for this compound, the professional judgment of the reviewer is that samples associated with this result should be flagged "E" or "UE" for estimated.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Phenol, Benzoic Acid, and bis(2-Ethylhexyl)phthalate were detected in the method blank with this Sample Delivery Group (SDG) but were all less than the reporting limit. One blank had bis(2-Ethylhexyl)phthalate above the reporting limit. The laboratory has already appropriately flagged the sample results with "B" to indicate presence of the compound in the blank. No additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for 2-Fluorophenol was out of criteria for Sample No. MWSS032R1. Per Functional Guidelines, no data flags are required unless at least two surrogates are out of criteria.

Surrogates were out of criteria in the Quality Control checks. No data flags are recommended because the surrogates were acceptable in the samples.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS016R1	Benzyl Alcohol	MS/MSD, BS/BSD	1.8 E
MWSS017R1	Benzyl Alcohol	MS/MSD, BS/BSD	5.0 E
MWSS018R1	Benzyl Alcohol	MS/MSD, BS/BSD	4.3 E
MWSS019R1	Benzyl Alcohol	MS/MSD, BS/BSD	7.1 E
MWSS020R1	Benzyl Alcohol	MS/MSD, BS/BSD	1.8 E
MWSS021R1	Benzyl Alcohol	MS/MSD, BS/BSD	5.9 E
MWSS023R1	Benzyl Alcohol	MS/MSD, BS/BSD	1.1 E
MWSS027R1	Benzyl Alcohol	MS/MSD, BS/BSD	3.3 E
MWSS032R1	Benzyl Alcohol	MS/MSD, BS/BSD	3.6 E
MWSS016R1	Benzo(g,h,i)perylene	MS/MSD, BS/BSD	66 E
MWSS017R1	Benzo(g,h,i)perylene	MS/MSD, BS/BSD	87 E

Discussion: Benzyl Alcohol and Benzo(g,h,i)perylene were out of criteria for accuracy with both the MS/MSD and the BS/BSD for the May 22, 1998 extraction batches. Benzyl Alcohol has been flagged results "E" and "UE" for estimated in all associated samples. Only Sample Nos. MWSS016R1 and MWSS017R1 are flagged "E" and "UE" for Benzo(g,h,i)perylene in the base/neutral fraction. The base/neutral extraction for the other samples in this sample delivery group were extracted on a different day. Sample Nos. MWSS027 R1 and MWSS032 R1 are also associated with these Quality Control checks but are not flagged because they have already been flagged "E" from the continuing calibration.

A single blank spike or a single matrix spike for several target compounds were out of criteria but all other accuracy measurements (e.g., the other matrix spike, the other blank spike, surrogates and calibration verifications) are acceptable and no data qualifier flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted that an internal standard was out of criteria on Sample Nos. MWSS027R1 and MWSS032R1, but it was not the internal standard used for reporting the only target compound (n-Nitrosodiphenylamine) from that injection, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(k)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

All TIC calculations, spectra, and library searches were reviewed and met the criteria of the referenced method. No TICs were detected in the laboratory blanks.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column that had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Discussion: On the analysis of May 18, 1998, the reviewer noted some retention time drift from the initial calibration, most likely due to column loading, column age, and/or column maintenance (clipping). However, based upon the daily calibration checks and surrogates, the reviewer concurs with the laboratory's identification of the target analytes.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS023R1	Aroclor 1260	Not Confirmed	50 U

Discussion: Due to a poor pattern match, the reviewer does not concur that Sample No. MWSS023R1 confirmed on the second column. This result is revised to non-detect at the laboratory's reporting limit.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, is acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data.

No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes and duplicates were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within laboratory or method criteria.

Associated Samples	Compound Affected	Type of Deviation	Flag
MWSS016R1	Antimony	Matrix Spike	4.6 UE
MWSS017R1	Antimony	Matrix Spike	6.1 UE
MWSS018R1	Antimony	Matrix Spike	4.8 UE
MWSS019R1	Antimony	Matrix Spike	5.4 UE
MWSS020R1	Antimony	Matrix Spike	3.7 UE
MWSS021R1	Antimony	Matrix Spike	5.4 UE
MWSS023R1	Antimony	Matrix Spike	3.8 UE
MWSS027R1	Antimony	Matrix Spike	5.4 UE
MWSS032R1	Antimony	Matrix Spike	12.1 E
MWSS016R1	Copper	Matrix Spike	139 E
MWSS017R1	Copper	Matrix Spike	83.2 E
MWSS018R1	Copper	Matrix Spike	110 E
MWSS019R1	Copper	Matrix Spike	77.5 E
MWSS020R1	Copper	Matrix Spike	51.3 E
MWSS021R1	Copper	Matrix Spike	117 E
MWSS023R1	Copper	Matrix Spike	68.2 E
MWSS027R1	Copper	Matrix Spike	237 E
MWSS032R1	Copper	Matrix Spike	1100 E

Discussion: Antimony and Copper were out of criteria in the matrix spike samples. All associated samples have been flagged as "E" or "UE" for estimated.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis was performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted five-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as noted below, no errors in accuracy were found.

Associated Samples	Compound Affected	Type of Deviation	Flag
MWSS020R1	Nickel	Calculation Error	10.3

Discussion: Calculation errors were found in determining the final results from percent moisture corrections, dilutions, and the amount of sample taken through preparation. The corrected value is listed in the summary table and on the laboratory final report form.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, is acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Error

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes and matrix duplicates were analyzed as required by the referenced method, and all percent recoveries and relative percent differences were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
278	MWSSO21R1	805058-3	8260	49	1,3-Dichlorobenzene	4.2	UE	Internal Standard
278	MWSSO21R1	805058-3	8260	50	1,4-Dichlorobenzene	4.2	UE	Internal Standard
278	MWSSO21R1	805058-3	8260	47	1,2-Dichlorobenzene	4.2	UE	Internal Standard
278	MWSSO21R1	805058-3	8260	38	1,2,4-Trichlorobenzene	10	UE	Internal Standard
278	MWSS021R1RE	805058-3RE	8260	77	Trichloroethene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	40	Tetrachloroethene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	39	Ethylbenzene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	53	(m+p)-Xylenes	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	41	o-Xylene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	49	1,3-Dichlorobenzene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	50	1,4-Dichlorobenzene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	47	1,2-Dichlorobenzene	8.3	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260	38	1,2,4-Trichlorobenzene	21	UR	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260		Methane, Thiobis	350	R	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260		Unknown Hydrcarbon @ RT=25.16	54.2	R	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260		Unknown Hydrcarbon @ RT=26.28	29.2	R	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260		Unknown Hydrcarbon @ RT=28.53	50	R	Excessive Dilution
278	MWSS021R1RE	805058-3RE	8260		Bicyclo(3.1.0)Hexan-3-one, 4-	91.7	R	Excessive Dilution
273	MWSS016R1	805058-1	8270	7	Benzyl Alcohol	1.8	E	MS/MSD & BS/BSD
274	MWSS017R1	805058-2	8270	7	Benzyl Alcohol	5.0	E	MS/MSD & BS/BSD
278	MWSS021R1	805058-3	8270	7	Benzyl Alcohol	5.9	E	MS/MSD & BS/BSD
275	MWSS018R1	805058-4	8270	7	Benzyl Alcohol	4.3	E	MS/MSD & BS/BSD
276	MWSS019R1	805058-5	8270	7	Benzyl Alcohol	7.1	E	MS/MSD & BS/BSD
277	MWSS020R1	805058-6	8270	7	Benzyl Alcohol	1.8	E	MS/MSD & BS/BSD
303	MWSS027R1	805058-7	8270	7	Benzyl Alcohol	3.3	E	MS/MSD & BS/BSD
321	MWSS032R1	805058-8	8270	7	Benzyl Alcohol	3.6	E	MS/MSD & BS/BSD
283	MWSS023R1	805058-9	8270	7	Benzyl Alcohol	1.1	E	MS/MSD & BS/BSD
273	MWSS016R1	805058-1	8270	4	Benzo(g,h,i)perylene	66	E	MS/MSD and BS/BSD
274	MWSS017R1	805058-2	8270	4	Benzo(g,h,i)perylene	87	E	MS/MSD and BS/BSD
277	MWSS020R1	805058-6	8270	18	Indeno(1,2,3-cd)pyrene	30	E	Continuing Calibration
277	MWSS020R1	805058-6	8270	12	Dibenzo(a,h)anthracene	31	UE	Continuing Calibration
277	MWSS020R1	805058-6	8270	4	Benzo(g.h,i)perylene	36	E	Continuing Calibration
303	MWSS027R1	805058-7	8270	18	Indeno(1,2,3-cd)pyrene	370	E	Continuing Calibration

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
303	MWSS027R1	805058-7	8270	12	Dibenzo(a,h)anthracene	160	E	Continuing Calibration
303	MWSS027R1	805058-7	8270	4	Benzo(g.h,i)perylene	380	E	Continuing Calibration
321	MWSS032R1	805058-8	8270	18	Indeno(1,2,3-cd)pyrene	460	E	Continuing Calibration
321	MWSS032R1	805058-8	8270	12	Dibenzo(a,h)anthracene	210	E	Continuing Calibration
321	MWSS032R1	805058-8	8270	4	Benzo(g.h,i)perylene	460	E	Continuing Calibration
283	MWSS023R1	805058-9	8082	44	Aroclor 1260	50	U	Not Confirmed
283	MWSS023R1	805058-9	8082	46	PCB Total	50	U	Not Confirmed
273	MWSS016R1	805058-1	6010	54	Antimony	5.4	UE	Matrix Spike
273	MWSS016R1	805058-1	6010	57	Copper	139	E	Matrix Spike
274	MWSS017R1	805058-2	6010	54	Antimony	6.1	UE	Matrix Spike
274	MWSS017R1	805058-2	6010	57	Copper	83.2	E	Matrix Spike
278	MWSS021R1	805058-3	6010	54	Antimony	5.4	UE	Matrix Spike
278	MWSS021R1	805058-3	6010	57	Copper	117	E	Matrix Spike
275	MWSS018R1	805058-4	6010	54	Antimony	4.8	UE	Matrix Spike
275	MWSS018R1	805058-4	6010	57	Copper	110	E	Matrix Spike
276	MWSS019R1	805058-5	6010	54	Antimony	5.4	UE	Matrix Spike
276	MWSS019R1	805058-5	6010	57	Copper	77.5	E	Matrix Spike
277	MWSS020R1	805058-6	6010	54	Antimony	3.7	UE	Matrix Spike
277	MWSS020R1	805058-6	6010	57	Copper	51.3	E	Matrix Spike
277	MWSS020R1	805058-6	6010	60	Nickel	10.3		Calculation Error
303	MWSS027R1	805058-7	6010	54	Antimony	5.4	UE	Matrix Spike
303	MWSS027R1	805058-7	6010	57	Copper	237	E	Matrix Spike
321	MWSS032R1	805058-8	6010	54	Antimony	12.1	E	Matrix Spike
321	MWSS032R1	805058-8	6010	57	Copper	1100	E	Matrix Spike
283	MWSS023R1	805058-9	6010	54	Antimony	3.8	UE	Matrix Spike
283	MWSS023R1	805058-9	6010	57	Copper	68.2	E	Matrix Spike

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805058

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 9

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	M	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	M	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	X	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	X	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	X	M	O	X	M	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol, Antimony and Copper, and continuing calibration checks for 3 PAHs on several samples. Two values for PCBs were not confirmed and revised to non-detect.

DATA EVALUATION SUMMARY

SDG No. 805058

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 9

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA						4		4	4/86 = 4.7%
SVOA			9		10			19	19/63 = 30.2%
PEST								0	0/45 = 0%
PCB							2	2	2/63 = 3.2%
METALS					18		1**	19	19/207 = 9.2%
INORG								0	0/56 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria. ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA							14	14	14/86 = 16.3%
SVOA								0	0/63 = 0%
PEST								0	0/45 = 0%
PCB								0	0/63 = 0%
METALS								0	0/207 = 0%
INORG								0	0/56 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 12, 1998
SDG No. 805067

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, 1994, as revised; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWSS037R1	805067-1	X	X	X	X	X	X	
MWSS037e1	805067-2	X	X	X	X	X	X	
MWSS024R1	805067-3	X	X	X	X	X	X	
MWSS025R1	805067-4	X	X	X	X	X	X	
MWSS022R1	805067-5	X	X	X	X	X	X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	119 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Water	91 pages	Thomas S. Davis	Lorraine L. Davis
Semivolatile Organics	Sediment	563 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	466 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	251 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Water	164 pages	Lorraine L. Davis	Thomas S. Davis
Metals	Sediment	130 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	39 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	22 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	11 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors were found.

Discussion: There is a break in Chain-of-Custody of one minute from the time the samples were relinquished by Foster Wheeler Environmental and when MultiChem Analytical accepted the samples.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS022R1	1,3-Dichlorobenzene	Internal Standard	3.3 UE
	1,4-Dichlorobenzene		3.3 UE
	1,2-Dichlorobenzene		3.3 UE
	1,2,4-Trichlorobenzene		8.3 UE
MWSS037R1	1,3-Dichlorobenzene	Internal Standard	4.1 UE
	1,4-Dichlorobenzene		4.1 UE
	1,2-Dichlorobenzene		4.1 UE
	1,2,4-Trichlorobenzene		10 UE

Discussion: The internal standard 1,4-Dichlorobenzene-d_4 was out of criteria for Sample Nos. MWSS022R1 and MWSS037R1. The associated compounds have been flagged with "E" or "UE" for estimated. Sample Nos. MWSS022R1RE and MWSS037R1RE are also affected by internal standards that are out of criteria, but are flagged "R" elsewhere in this report.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST022R1RE	All	Excessive Dilution	R
MWST037R1RE	All	Excessive Dilution	R

Discussion: Two samples were diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution. To condense the results to one result per analyte per sample, the results that are above the calibration range or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

D. Review of GC/MS Semi-Volatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. Except as noted below, no Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: A continuing calibration check for the target compound, di-n-Octylphthalate, had percent differences greater than the acceptance criteria but the reported results for this target analyte was reported from a different day's analysis, and no data qualifier flags are recommended.

Several continuing calibration checks had large percent differences for several other target compounds but have no method or QAPP criteria. In addition, these target compounds were reported from other dates of analysis, and no data qualifier flags are recommended.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, bis(2-Ethylhexyl)phthalate, and Phenol were detected in the method blank analyzed with this Sample Delivery Group (SDG) but were less than the reporting limit. The laboratory has already flagged the samples with "B" to indicate the analyte was detected in the samples and the method blank.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Surrogates were out of criteria in the blank spike and blank spike duplicate. No data flags are recommended because the surrogates are acceptable in the samples.

The percent recovery for 2-Fluorobiphenyl in Sample MWSS025R1 was out of criteria. Per Functional Guidelines, no data flags are required unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS037R1	Benzyl Alcohol Benzo(g,h,i)perylene	MS/MSD, BS/BSD	9.8 E 400 E
MWSS022R1	Benzyl Alcohol Benzo(g,h,i)perylene	MS/MSD, BS/BSD	1.8 E 220 E

Discussion: Benzyl Alcohol and Benzo(g,h,i)perylene was out of criteria for accuracy and precision in both the Matrix Spike and Matrix Spike Duplicate. The associated samples have been flagged with "E" and "UE" for estimated.

Several analytes were out of criteria for accuracy or precision on one of the matrix spikes, matrix spike duplicates, blank spikes or blank spike duplicates but all other accuracy measurements (e.g., the other matrix spike, the other blank spike, surrogates and calibration verifications) are acceptable and no data qualifying flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column that had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for Sample No. MWSS037e1 was out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Discussion: The laboratory noted that the positive hit for Sample No. MWSS037e1 exceeded the CLP criteria of 25% difference for quantitation on two columns and has already flagged the results. These results are within the 40% difference criterion recommended by EPA Method 8000B and the laboratory has reported the higher of the two results appropriately. No additional qualifier flags are recommended.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS024R1	Aroclor 1254	Not confirmed	78 U

Discussion: Due to a poor pattern match, the reviewer does not concur that Sample No. MWSS024R1 confirmed on the second column. This result is revised to non-detect at the labs reporting limit.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSS022R1	Mercury	MS/MSD	2.2 E
MWSS024R1	Mercury	MS/MSD	0.29 E
MWSS025R1	Mercury	MS/MSD	5.9 E
MWSS037R1	Mercury	MS/MSD	1.4 E

Discussion: Matrix spike and matrix spike duplicate recoveries were out of criteria due to high concentrations of analytes in the original sample. The laboratory has already flagged the data appropriately with "N" to indicate the recovery was out of criteria. An additional data qualifier flag of "E" for estimated had been added.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis was performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

The Relative Percent Difference (RPD) for Sample No. MWSS034R1 is listed as 200%. The RPD is not calculable since one value is just above the reporting limit and one value is below the reporting limit. No data qualifier flags are recommended.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
330	MWSS037R1	805067-1	8260	49	1,3-Dichlorobenzene	4.1	UE	Internal Standard
330	MWSS037R1	805067-1	8260	50	1,4-Dichlorobenzene	4.1	UE	Internal Standard
330	MWSS037R1	805067-1	8260	47	1,2-Dichlorobenzene	4.1	UE	Internal Standard
330	MWSS037R1	805067-1	8260	38	1,2,4-Trichlorobenzene	10	UE	Internal Standard
330	MWSS037R1RE	805067-1 RE	8260	77	Trichloroethene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	40	Tetrachloroethene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	39	Ethylbenzene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	53	(m+p)-Xylenes	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	41	o-Xylene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	49	1,3-Dichlorobenzene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	50	1,4-Dichlorobenzene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	47	1,2-Dichlorobenzene	8.2	UR	Excessive Dilution
330	MWSS037R1RE	805067-1 RE	8260	38	1,2,4-Trichlorobenzene	20	UR	Excessive Dilution
280	MWSS022R1	805067-5	8260	49	1,3-Dichlorobenzene	3.3	UE	Internal Standard
280	MWSS022R1	805067-5	8260	50	1,4-Dichlorobenzene	3.3	UE	Internal Standard
280	MWSS022R1	805067-5	8260	47	1,2-Dichlorobenzene	3.3	UE	Internal Standard
280	MWSS022R1	805067-5	8260	38	1,2,4-Trichlorobenzene	8.3	UE	Internal Standard
280	MWSS022R1RE	805067-5 RE	8260	77	Trichloroethene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	40	Tetrachloroethene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	39	Ethylbenzene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	53	(m+p)-Xylenes	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	41	o-Xylene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	49	1,3-Dichlorobenzene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	50	1,4-Dichlorobenzene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	47	1,2-Dichlorobenzene	8.3	UR	Excessive Dilution
280	MWSS022R1RE	805067-5 RE	8260	38	1,2,4-Trichlorobenzene	21	UR	Excessive Dilution
330	MWSS037R1	805067-1	8270	7	Benzyl Alcohol	9.8	UE	MS/MSD and BS/BSD
280	MWSS022R1	805067-5	8270	7	Benzyl Alcohol	1.8	E	MS/MSD and BS/BSD
330	MWSS037R1	805067-1	8270	4	Benzo(g,h,i)perylene	400	E	MS/MSD and BS/BSD
280	MWSS022R1	805067-5	8270	4	Benzo(g,h,i)perylene	220	E	MS/MSD and BS/BSD
286	MWSS024R1	805067-3	8082	66	Aroclor 1254	78	U	Not Confirmed
330	MWSS037R1	805067-1	7471	59	Mercury	1.4	E	MS/MSD
286	MWSS024R1	805067-3	7471	59	Mercury	0.29	E	MS/MSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
293	MWSS025R1	805067-4	7471	59	Mercury	5.9	E	MS/MSD
280	MWSS022R1	805067-5	7471	59	Mercury	2.2	E	MS/MSD

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805067

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 5

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	X	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	M	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	M	X	O	O	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved internal standards associated with several Dichlorobenzenes. A PAH, Benzyl Alcohol and Mercury were qualified due to MS/MSD and BS/BSD failures. A single PCB result was revised to ND because it did not confirm.

DATA EVALUATION SUMMARY

SDG No. 805067

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 5

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA						8		8	8/56 =	14.3%
SVOA					4			4	4/35 =	11.4%
PEST								0	0/25 =	0%
PCB							2	2	2/35 =	5.7%
METALS					4			4	4/115	3.5%
INORG								0	0/35 =	0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA							18	18	18/56 =	32.1%
SVOA								0	0/35 =	0%
PEST								0	0/25 =	0%
PCB								0	0/35 =	0%
METALS								0	0/115 =	0%
INORG								0	0/35 =	0%

Note: Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 18, 1998
SDG No. 805072

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The size of the data packages, the data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SV	PEST	PCB	MET	INORG	TBT
MWST054R1	805072-1	X	X	X	X	X	X	
MWST049R1	805072-2	X	X	X	X	X	X	
MWST040R1	805072-3	X	X	X	X	X	X	
MWST040S1	805072-4		X	X	X	X	X	

Key:

VOA	=	Volatile Organic Compounds
SV	=	Semi-volatile Organic Compounds
PEST	=	Chlorinated Pesticides
PCB	=	Polychlorinated Biphenyls
MET	=	Trace Metals
INORG	=	Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT	=	Tributyl Tin

Table 2: Data, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	150 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	684 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	222 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	182 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	138 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	45 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	24 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	7 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The time the samples were relinquished to the laboratory by Carol Hutley is not noted on the Chain-of-Custody.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

Samples No. MWST041R1 and MWST040S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST049R1	1,3-Dichlorobenzene	Internal Standard	3.2 UE
	1,4-Dichlorobenzene		3.2 UE
	1,2-Dichlorobenzene		3.2 UE
	1,2,4-Trichlorobenzene		7.9 UE
MWST054R1	1,3-Dichlorobenzene	Internal Standard	5.0 UE
	1,4-Dichlorobenzene		5.0 UE
	1,2-Dichlorobenzene		5.0 UE
	1,2,4-Trichlorobenzene		12 UE

Discussion: The internal standard 1,4-Dichlorobenzene-d_4 was out of criteria for Samples No. MWST049R1 and MWST054R1. The associated compounds have been flagged with "E" or "UE" for estimated. Samples No.MWST049R1RE and MWST054R1RE are also affected by internal standards that are out of criteria, but are flagged "R" elsewhere in this report.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST049R1RE	All	Excessive Dilution	R
MWST054R1RE	All	Excessive Dilution	R

Discussion: Two samples were diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution. To condense the results to one result per analyte per sample, the results that are above the calibration range or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

All TIC calculations, spectra, and library searches were reviewed and met the criteria of the referenced method. In Sample No. MWST054R1, tentatively identified compounds were reported. The laboratory has already flagged the results with "NJ" for tentatively identified with estimated concentrations.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data for samples that are flagged with an "R" are not acceptable for use. The analyses were not within the requirements of the referenced method and significant discrepancies were observed between raw data and reported data results. However, those compounds that were flagged "R," were the reanalysis of the samples. All samples still have reported values for each analyte.

For the other samples, the data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semi-Volatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. Except as noted below, there are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: The original acid extraction for Sample No. MWST054R1 was lost but the laboratory re-extracted and analyzed an aliquot that had been frozen within 14 days of sampling. The PSEP holding time for frozen sediments is one year and no data qualifier flags are recommended.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. Except as noted below, no Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Several continuing calibration checks had large percent differences for several target compounds but have no method or QAPP criteria. In addition, these target compounds were reported from other dates of analysis, and no data qualifier flags are recommended.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, bis(2-Ethylhexyl)phthalate, and Phenol were detected in the method blank analyzed with this Sample Delivery Group (SDG) but were less than the reporting limit. The laboratory has already flagged the samples with "B" to indicate the analyte was detected in the samples and the method blank.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Surrogates were out of criteria in the blanks associated with the concentrated extracts that were analyzed for n-Nitrosodiphenylamine. No data flags are recommended because the surrogates were acceptable in the samples and in the original, unconcentrated analysis.

The percent recovery for Nitribenzene-d_5 was out of criteria in a matrix spike and a blank spike. No data flags are recommended because the surrogates were acceptable in the samples.

The case narrative discussed that the surrogate 2-Fluorobiphenyl was out of criteria for the concentrated reanalysis of Sample No. MWSS026S1RE, along with the blank and blank spike. This sample is part of a different SDG that was analyzed as part of the same extraction batch, and the reference to this sample should be deleted from the case narrative. The laboratory has been contacted to revise the case narrative and issue the revision directly to Foster Wheeler.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST054R1	Benzyl Alcohol	MS/MSD, BS/BSD	6.0 E
	Benzo(a)pyrene		1900 E
MWST049R1	Benzyl Alcohol	MS/MSD, BS/BSD	3.2 E
	Benzo(a)pyrene		240 E
MWST040R1	Benzyl Alcohol	MS/MSD, BS/BSD	1.3 E
	Benzo(a)pyrene		300 E
MWST040S1	Benzyl Alcohol	MS/MSD, BS/BSD	1.7 E
	Benzo(a)pyrene		330 E

Discussion: Benzyl Alcohol and Benzo(a)pyrene were out of criteria for accuracy and precision in both the matrix spike, matrix spike duplicate and the blank spike, blank spike duplicate. The associated samples have been flagged with "E" and "UE" for estimated.

Several analytes were out of criteria for accuracy or precision on one of the matrix spikes, matrix spike duplicates, blank spikes or blank spike duplicates but all other accuracy measurements (e.g., the other matrix spike, the other blank spike, surrogates and calibration verifications) are acceptable and no data qualifier flags are recommended.

Pyrene was out of the laboratory's criteria for accuracy on the matrix spike and for precision on the blank spike, blank spike duplicate, but was within the QAPP criteria. No data qualifier flags are recommended.

7. Field Duplicates

Samples No. MWST040R1 and MWST040S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data

validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWST040R1 Initial Result	MWST040S1 Duplicate Result	RPD
Phenol	27	110	121.2
Benzyl Alcohol	1.3	1.7	26.7
2-Methylphenol	2.6	3.6	32.3
4-Methylphenol	65	98	40.5
2,4-Dimethylphenol	2.5	3.4	30.5
Benzoic Acid	66	58	12.9
Pentachlorophenol	2.0	3.3	49.1
Mean RPD Acid Fraction			**44.7**
Standard Deviation			**35.5**
Naphthalene	300	840	94.7
2-Methylnaphthalene	94	220	80.3
Acenaphthylene	86	130	40.7
Acenaphthene	85	180	71.7
Dibenzofuran	96	160	50.0
Diethylphthalate	32	ND	NC
Fluorene	120	200	50.0
Phenanthrene	490	720	38.0
Anthracene	180	300	50.0
di-n-Butylphthalate	12	ND	NC
Fluoranthene	620	920	39.0
Pyrene	730	980	29.2
Benzo(a)anthracene	270	320	16.9
Chrysene	340	400	16.2
bis(2-Ethylhexyl)phthalate	160	150	6.5
Benzo(b)fluoranthene	60	570	161.9
Benzo(k)fluoranthene	60	570	161.9
Benzo(a)pyrene	300	330	9.5
Indeno(1,2,3-cd)pyrene	14	130	161.1
Dibenzo(a,h)anthracene	33	ND	NC
Benzo(g,h,i)perylene	60	150	85.7
Mean RPD, B/N			**64.6**
Standard Deviation			**51.3**

Key: ND = Not Detected NC = Not Calculable

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: Chrysene-d_{12} and Perylene-d_{12} were out of criteria for Sample No. MWST054R1 on several dilutions, however, the laboratory appropriately reanalyzed the sample with acceptable results. No data qualifier flags are recommended.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(k)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

All TIC calculations, spectra, and library searches were reviewed and met the criteria of the referenced method. No TICs were detected in the laboratory blanks.

Discussion: In Sample No. MWST054R1, tentatively identified compounds were reported. As required by Functional Guidelines, all TIC results have already been flagged with "NJ" for tentatively identified with estimated concentration.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephone Kim Lofgren at MultiChem Analytical Services during the data validation process so that the QBD project manager could request that the case narrative be revised to delete Sample No. MWSS026S1. This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column that had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl were out of criteria for three Continuing Calibration Verification standards, but no data flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCT049R1	Hexachlorobutadiene	MS/MSD	2.6 UE

Discussion: Although there is no acceptance criteria listed in the QAPP, the reviewer considered the percent recovery of Hexachlorobutadiene to be low at 38 % and 42% recovery for the MS/MSD pair. Because the Blank Spike and Blank Spike Duplicate were acceptable, only the sample used for the matrix spike is flagged "E" for estimated for this analyte, and no other data qualifier flags are recommended for the other samples in the batch.

6. Field Duplicates

Samples No. MWST040R1 and MWST040S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl on a Continuing Calibration Verification standard was out of criteria, but no data flags are recommended because this result is a QC check and all surrogates for the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Samples No. MWST040R1 and MWST040S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timelines and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST054R1	Mercury	MS/MSD	0.83 E
MWST049R1	Mercury	MS/MSD	0.21 E
MWST040R1	Mercury	MS/MSD	0.38 E
MWST040ST	Mercury	MS/MSD	0.26 E

Discussion: Matrix spike and matrix spike duplicate recoveries were out of criteria due to high concentrations of analytes in the original sample. The laboratory has already flagged the data appropriately with "N" to indicate the recovery was out of criteria. An additional data qualifier flag of "E" for estimated had been added.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis was performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

Samples No. MWST040R1 and MWST040S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWST040R1 Initial Result	MWST040S1 Duplicate Result	RPD
Arsenic	5.8	6.3	8.3
Copper	62.4	81.7	26.8
Lead	33.1	47.5	35.7
Mercury	0.38	0.26	37.5
Nickel	6.5	7.6	15.6
Zinc	45.6	57.1	22.4
Mean RPD			**24.4**
Standard Deviation			**11.4**

Key:
ND = Not Detected NC = Not Calculable

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The concentration of the spiking compound for Total Organic Carbon was less than the concentration of the sample. No data qualifier flags are recommended because the percent recovery was with in criteria.

6. Field Duplicates

Samples No. MWST040R1 and MWST040S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWST040R1 Initial Result	MWST040S1 Duplicate Result	RPD
Total Organic Carbon	14400	17100	17.1
Percent Moisture (Multichem Lab)	35	44	22.8
Total Solids (CAS Lab)	66.2	67.3	1.6
Ammonia	4.2	4.5	6.9
Sulfide	5	4	22.2
Mean RPD			**14.1**
Standard Deviation			**9.5**

Key:
ND = Not Detected NC = Not Calculable

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
370	MWST054R1	805072-1	8260	49	1,3-Dichlorobenzene	5.0	UE	Internal Standard
370	MWST054R1	805072-1	8260	50	1,4-Dichlorobenzene	5.0	UE	Internal Standard
370	MWST054R1	805072-1	8260	47	1,2-Dichlorobenzene	5.0	UE	Internal Standard
370	MWST054R1	805072-1	8260	38	1,2,4-Trichlorobenzene	12	UE	Internal Standard
370	MWST054R1	805072-1	7471	59	Mercury	0.83	E	MS/MSD
370	MWST054R1RE	805072-1 RE	8260	77	Trichloroethene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	40	Tetrachloroethene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	39	Ethylbenzene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	53	(m+p)-Xylenes	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	41	o-Xylene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	49	1,3-Dichlorobenzene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	50	1,4-Dichlorobenzene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	47	1,2-Dichlorobenzene	10	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260	38	1,2,4-Trichlorobenzene	25	UR	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260		Unknown @ RT=4.74	45	R	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260		Methane, Thiobis	30	R	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260		Unknown @ RT=32.60	35	R	Excessive Dilution
370	MWST054R1RE	805072-1 RE	8260		Unknown @ RT=33.31	30	R	Excessive Dilution
358	MWST049R1	805072-2	8260	49	1,3-Dichlorobenzene	3.2	UE	Internal Standard
358	MWST049R1	805072-2	8260	50	1,4-Dichlorobenzene	3.2	UE	Internal Standard
358	MWST049R1	805072-2	8260	47	1,2-Dichlorobenzene	3.2	UE	Internal Standard
358	MWST049R1	805072-2	8260	38	1,2,4-Trichlorobenzene	7.9	UE	Internal Standard
358	MWST049R1RE	805072-2 RE	8260	77	Trichloroethene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	40	Tetrachloroethene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	39	Ethylbenzene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	53	(m+p)-Xylenes	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	41	o-Xylene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	49	1,3-Dichlorobenzene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	50	1,4-Dichlorobenzene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	47	1,2-Dichlorobenzene	7.9	UR	Excessive Dilution
358	MWST049R1RE	805072-2 RE	8260	38	1,2,4-Trichlorobenzene	20	UR	Excessive Dilution
370	MWST054R1	805072-1	8270	7	Benzyl Alcohol	6	UE	MS/MSD and BS/BSD
370	MWST054R1	805072-1	8270	2	Benzo(a)pyrene	1200	UE	MS/MSD and BS/BSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
358	MWST049R1	805072-2	8270	7	Benzyl Alcohol	3.2	UE	MS/MSD and BS/BSD
358	MWST049R1	805072-2	8270	2	Benzo(a)pyrene	300	UE	MS/MSD and BS/BSD
338	MWST040R1	805072-3	8270	7	Benzyl Alcohol	1.3	UE	MS/MSD and BS/BSD
338	MWST040R1	805072-3	8270	2	Benzo(a)pyrene	330	UE	MS/MSD and BS/BSD
341	MWST040S1	805072-4	8270	7	Benzyl Alcohol	1.7	UE	MS/MSD and BS/BSD
341	MWST040S1	805072-4	8270	2	Benzo(a)pyrene	240	UE	MS/MSD and BS/BSD
358	MWST049R1	805072-2	8081	36	Hexachlorobutadiene	2.6	UE	MS/MSD
358	MWST049R1	805072-2	7471	59	Mercury	0.21	E	MS/MSD
338	MWST040R1	805072-3	7471	59	Mercury	0.38	E	MS/MSD
341	MWST040S1	805072-4	7471	59	Mercury	0.26	E	MS/MSD

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805072

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 4

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	M	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	M	M	O	O	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved internal standards associated with several Dichlorobenzenes. Benzo(a)pyrene, Benzyl Alcohol, and Mercury on several samples due to MS/MSD and BS/BSD failures.

DATA EVALUATION SUMMARY

SDG No. 805072

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 4

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA						8		8	8/48 =	16.7%
SVOA					8			8	8/28 =	28.6%
PEST					1			1	1/20 =	5.0%
PCB								0	0/28 =	0%
METALS					4			4	4/92 =	4.3%
INORG								0	0/28 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	ID	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA							22	22	22/48 =	45.6%
SVOA								0	0/28 =	0%
PEST								0	0/20 =	0%
PCB								0	0/28 =	0%
METALS								0	0/92 =	0%
INORG								0	0/28 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 19, 1998
SDG No. 805075

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 2 Data Qualification Summary
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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, as revised, 1994; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer, and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWST039R1	805075-1	X	X	X	X	X	X	
MWST048R1	805075-2	X	X	X	X	X	X	
MWST043R1	805075-3	X	X	X	X	X	X	
MWST052R1	805075-4	X	X	X	X	X	X	
MWST040E1	805075-5	X	X	X	X	X		

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	153 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Water	86 pages	Thomas S. Davis	Lorraine L. Davis
Semivolatile Organics	Sediment	646 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Water	222 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	293 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Water	100 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	196 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Water	117 pages	Lorraine L. Davis	Thomas S. Davis
Metals	Sediment	130 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	50 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	18 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	7 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The samples were taken on May 19, 1998. The samples were received by the laboratory at a temperature of 6.5°C on May 20, 1998. A Corrective Action Form was generated stating that the temperature of the samples was out of acceptance criteria of 4 ± 2°C, but there was no indication that the client was notified of the incident nor is there a supervisory signature indicating approval of the Corrective Action.

There is a three minute break in the chain-of-custody from the time the samples were relinquished by Carol Hutley and the time the laboratory received the sample.

There were obliterations and changes made to the chain-of-custody without initials and dates.

The chain-of-custody for samples subcontracted to both the Columbia Analytical Services and the Rosa Environmental and Biotechnical Laboratory shows a break in custody from the time the samples were relinquished by MultiChem Analytical Services to when the samples were accepted by each laboratory. There is no documentation such as bill of lading or airbill to indicate a courier service was used.

Foster Wheeler has investigated this issue and the sample shipping codes are on file with Multichem and Federal Express. No further action is required.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Pages 69, 70, and 71 (Form VI) are missing from the data package. The laboratory had been contacted to provide the data.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no written or verbal communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. Except as noted below, all samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Associated Samples	Analysis	Date Sampled	Date Extracted	Date Analyzed	Flag
MWST040e1	8270	5/19/98	6/1/98	6/10/98	All UE

Discussion: The analysis of Sample No. MWST040e1 exceeded the holding time by six days. All non-detects have been flagged with a "UE" for estimated reporting limit.

The laboratory had extracted Sample No. MWST048R1 and MWST054R1 within the initial fourteen day holding time, but the extract was lost. At the time of extraction, the laboratory had also frozen a portion of the sample. This frozen aliquot was thawed and re-analyzed after fourteen days had elapsed. Because PSEP recommendations list a one-year holding time for frozen sediments for this analysis, the holding time was not exceeded.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and

all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST040e1	Benzidine	Continuing Calibration	94 UE

Discussion: A continuing calibration check for the target compound Benzidine had a percent difference greater than the acceptance criteria and the result in Sample MWST0404e1 is flagged "UE" for an estimated reporting limit.

Several continuing calibration checks were out of criteria for various dates of analysis. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from a different analytical batch that had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, Phenol, and bis(2-Ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Several samples and quality control check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST043R1	Benzyl Alcohol Benzo(g,h,i)perylene	MS/MSD & BS/BSD	3.1 E 290 E
MWST052R1	Benzyl Alcohol Benzo(g,h,i)perylene	MS/MSD & BS/BSD	3.2 E 480 E
MWST039R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD & BS/BSD	2.7 E 29 E
MWST039R1	Benzo(a)pyrene	BS/BSD	1200 E
MWST048R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD & BS/BSD	3.8 E 13 E
MWST048R1	Benzo(a)pyrene	BS/BSD	1700 E

Discussion: Benzyl Alcohol and 2,4-Dimethylphenol were out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pairs associated with Samples No. MWS039R1 and MWST048R1. Benzo(g,h,i)perylene was out of criteria for both the MS/MSD and the BS/BSD pairs associated with Samples MWST043R1 and MWST052R1. All associated samples have been flagged as "E" for estimated.

Benzo(a)pyrene was out of criteria for accuracy in the BS/BSD pair associated with the re-extraction of Samples No. MWST039R1 and MMWST048R1. The laboratory failed to extract a MS/MSD pair with this batch, and both samples are flagged "E" for estimated for this analyte.

Several other analytes were out of criteria for a single blank spike or matrix spike but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) were acceptable, and/or the percent recovery was within QAPP criteria. No additional data qualifier flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column that had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for three Continuing Calibration Verification standards were out of criteria, but no data flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: Although there is no acceptance criteria listed in the QAPP, the reviewer considered the percent recovery of Hexachlorobutadiene to be low at 38 % and 42% recovery for the MS/MSD pair. Because the Blank Spike and Blank Spike Duplicate were acceptable, only the sample used for the matrix spike (which was in a different SDG) was flagged for this analyte, and no other data qualifier flags are recommended for the other samples in the batch.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Associated Samples	Analytes	Date Sampled	Date Extracted	Date Analyzed	Flag
MWST040e1	All Aroclor	5/19/98	6/1/98	6/4/98	0.94 UE

Discussion: The analysis of Sample No. MWST040e1 exceeded the holding time by six days. All non-detects should be flagged with an "UE" for estimated reporting limit.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl in Sample No. MWST040e1 was out of criteria, but per Functional Guidelines and the referenced method, no data qualifier flags are recommended unless two surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: A single blank spike of Aroclor 1016/1260 that was associated with Sample No. MWST0404e1 was out of criteria but all other accuracy measurements (e.g., the blank spike duplicate, matrix spikes, surrogates, and calibration verifications) were acceptable and no data qualifier flags are recommended.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and, except as noted below, no analytes were detected or levels were below the reporting limit.

Discussion: Copper was detected in the blank associated with Sample Nos. MWST039R1, MWST048R1, MWST043R1, and MWST052R1. No data qualifier flags are recommended because the concentration of copper in the samples are greater than ten times the concentration of copper in the blank.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST039R1	Mercury	MS/MSD	0.36 E
MWST048R1	Mercury	MS/MSD	0.37 E
MWST043R1	Mercury	MS/MSD	0.39 E
MWST052R1	Mercury	MS/MSD	0.28 E

Discussion: Matrix spike and matrix spike duplicate recoveries were out of criteria due to high concentrations of analytes in the original sample. The laboratory has already flagged the data appropriately with "N" to indicate the recovery was out of criteria. An additional data qualifier flag of "E" for estimated had been added.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: The samples were received at Columbia Analytical Services at a temperature of 6.2°C, just above the criteria of 4 ± 2°C. In the professional opinion of the viewer, the slightly elevated temperature does not impact the quality of the data and no data qualifier flags are recommended.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Associated Samples	Analyte	Type of Deviation	Flag
MWST048R1	Ammonia	Transcription Error	9.5
MWST043R1	Ammonia	Transcription Error	8.4

Discussion: Transcription errors were found in determining the final results. Corrected values are listed in the summary table and on the laboratory final report forms.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
409	MWST040e1	805075-5	8270	121	n-Nitrosodimethylamine	9	UE	Holding Time
409	MWST040e1	805075-5	8270	24	Phenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	114	Aniline	9	UE	Holding Time
409	MWST040e1	805075-5	8270	117	bis(2-Chloroethyl)ether	9	UE	Holding Time
409	MWST040e1	805075-5	8270	101	2-Chlorophenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	49	1,3-Dichlorobenzene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	50	1,4-Dichlorobenzene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	7	Benzyl Alcohol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	47	1,2-Dichlorobenzene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	72	2-Methylphenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	93	2,2'-Oxybis(1-chlorpropane)	9	UE	Holding Time
409	MWST040e1	805075-5	8270	106	3/4-Methylphenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	122	n-Nitroso-di-n-propylamine	9	UE	Holding Time
409	MWST040e1	805075-5	8270	119	Hexachloroethane	9	UE	Holding Time
409	MWST040e1	805075-5	8270	123	Nitrobenzene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	120	Isophorone	9	UE	Holding Time
409	MWST040e1	805075-5	8270	103	2-Nitrophenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	68	2,4-Dimethylphenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	6	Benzoic Acid	47	UE	Holding Time
409	MWST040e1	805075-5	8270	116	bis(2-Chloroethyoxy)methane	9	UE	Holding Time
409	MWST040e1	805075-5	8270	96	2,4-Dichlorophenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	38	1,2,4-Trichlorobenzene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	20	Naphthalene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	110	4-Chloroaniline	9	UE	Holding Time
409	MWST040e1	805075-5	8270	36	Hexachlorobutadiene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	109	4-Chloro-3-methylphenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	71	2-Methylnaphthalene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	118	Hexachlorocyclopentadiene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	95	2,4,6-Trichlorophenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	94	2,4,5-Trichlorophenol	47	UE	Holding Time
409	MWST040e1	805075-5	8270	100	2-Chloronaphthalene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	103	2-Nitroaniline	47	UE	Holding Time
409	MWST040e1	805075-5	8270	15	Dimethylphthalate	9	UE	Holding Time

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
409	MWST040e1	805075-5	8270	75	Acenaphthylene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	105	3-Nitroaniline	47	UE	Holding Time
409	MWST040e1	805075-5	8270	74	Acenaphthene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	97	2,4-Dinitrophenol	47	UE	Holding Time
409	MWST040e1	805075-5	8270	113	4-Nitrophenol	47	UE	Holding Time
409	MWST040e1	805075-5	8270	13	Dibenzofuran	9	UE	Holding Time
409	MWST040e1	805075-5	8270	98	2,4-Dinitrotoluene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	99	2,6-Dinitrotoluene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	14	Diethylphthalate	9	UE	Holding Time
409	MWST040e1	805075-5	8270	111	4-Chlorophenyl-phenyl ether	9	UE	Holding Time
409	MWST040e1	805075-5	8270	17	Fluorene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	112	4-Nitroaniline	47	UE	Holding Time
409	MWST040e1	805075-5	8270	107	4,6-Dinitro-2-methylphenol	47	UE	Holding Time
409	MWST040e1	805075-5	8270	19	n-Nitrosodiphenylamine	3	E	Holding Time
409	MWST040e1	805075-5	8270	108	4-Bromophenyl-phenyl ether	9	UE	Holding Time
409	MWST040e1	805075-5	8270	35	Hexachlorobenzene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	22	Pentachlorophenol	9	UE	Holding Time
409	MWST040e1	805075-5	8270	23	Phenanthrene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	76	Anthracene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	10	di-n-Butylphthalate	9	UE	Holding Time
409	MWST040e1	805075-5	8270	16	Fluoranthene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	115	Benzidine	94	UE	Holding Time & Continuing Calibration
409	MWST040e1	805075-5	8270	26	Pyrene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	8	Butylbenzylphthalate	9	UE	Holding Time
409	MWST040e1	805075-5	8270	104	3,3'-Dichlorbenzidine	19	UE	Holding Time
409	MWST040e1	805075-5	8270	1	Benzo(a)anthracene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	28	Bis(2-ethylhexyl)phthalate	2	E	Holding Time
409	MWST040e1	805075-5	8270	9	Chrysene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	11	di-n-Octylphthalate	9	UE	Holding Time
409	MWST040e1	805075-5	8270	3	Benzo(b)fluoranthene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	5	Benzo(k)fluoranthene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	2	Benzo(a)pyrene	9	UE	Holding Time

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
409	MWST040e1	805075-5	8270	18	Indeno(1,2,3-cd)pyrene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	12	Dibenzo(a,h)anthracene	9	UE	Holding Time
409	MWST040e1	805075-5	8270	4	Benzo(g.h,i)perylene	9	UE	Holding Time
344	MWST043R1	805075-3	8270	7	Benzyl Alcohol	3.1	E	MS/MSD & BS/BSD
344	MWST043R1	805075-3	8270	4	Benzo(g,h,i)perylene	290	E	MS/MSD & BS/BSD
397	MWST052R1	805075-4	8270	7	Benzyl Alcohol	3.2	E	MS/MSD & BS/BSD
397	MWST052R1	805075-4	8270	4	Benzo(g,h,i)perylene	480	E	MS/MSD & BS/BSD
332	MWST039R1	805075-1	8270	7	Benzyl Alcohol	2.7	E	MS/MSD & BS/BSD
332	MWST039R1	805075-1	8270	68	2,4-Dimethylphenol	29	E	MS/MSD & BS/BSD
332	MWST039R1	805075-1	8270	2	Benzo(a)pyrene	1200	E	BS/BSD
356	MWST048R1	805075-2	8270	7	Benzyl Alcohol	3.8	E	MS/MSD & BS/BSD
356	MWST048R1	805075-2	8270	68	2,4-Dimethylphenol	13	E	MS/MSD & BS/BSD
356	MWST048R1	805075-2	8270	2	Benzo(a)pyrene	1700	E	BS/BSD
409	MWST040e1	805075-5	8082	63	Aroclor 1016	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	42	Aroclor 1221	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	64	Aroclor 1232	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	65	Aroclor 1242	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	43	Aroclor 1248	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	66	Aroclor 1254	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	44	Aroclor 1260	0.94	UE	Holding Time
409	MWST040e1	805075-5	8082	46	Total PCB	0.94	UE	Holding Time
332	MWST039 R1	805075-1	7471	59	Mercury	0.36	E	MS/MSD
356	MWST048 R1	805075-2	7471	59	Mercury	0.37	E	MS/MSD
344	MWST043 R1	805075-3	7471	59	Mercury	0.39	E	MS/MSD
397	MWST052 R1	805075-4	7471	59	Mercury	0.28	E	MS/MSD
356	MWST048 R1	805075-2	350.1	30	Ammonia	9.5		Calculation Error
344	MWST043 R1	805075-3	350.1	30	Ammonia	8.4		Calculation Error

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805075

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 5

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	M	O	M	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	X	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	M	O	M	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Holding time was exceeded for a single sample for PCBs and BNAs. Benzo(a)pyrene, Benzyl Alcohol, Benzo(g,h,i)perlyene, 2,4-Dimethylphenol, and Mercury were qualified due to MS/MSD and BS/BSD failures. Two ammonia results were revised due to calculation errors.

DATA EVALUATION SUMMARY

SDG No. 805075

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 5

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA								0	0/40 = 0%
SVOA		68			10			78	78/96 = 81.3%
PEST								0	0/25 = 0%
PCB		8						8	8/35 = 22.8%
METALS					4			4	4/115 = 3.4%
INORG							2**	2	2/35 = 5.7%

Note Asterisk (*) indicates additional exceedances of review criteria. ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/40 = 0%
SVOA								0	0/96 = 0%
PEST								0	0/25 = 0%
PCB								0	0/35 = 0%
METALS								0	0/115 = 0%
INORG								0	0/35 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 20, 1998
SDG No. 805082

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 12/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, as revised, 1994; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWST044R1	805082-1	X	X	X	X	X	X	
MWST047R1	805082-2	X	X	X	X	X	X	
MWST051R1	805082-3	X	X	X	X	X	X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	101 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	451 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	241 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	202 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	136 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	41 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	18 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Sediment	5 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: There are obliterations and/or changes made on the Chain-of-Custody without initials or dates.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for Toluene-d_8 in Sample No. MWST051R1RE was out of criteria, but per Functional Guidelines, no data flags are required unless two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST044R1	1,3-Dichlorobenzene	Internal Standard	4.9 UE
	1,4-Dichlorobenzene		4.9 UE
	1,2-Dichlorobenzene		4.9 UE
	1,2,4-Trichlorobenzene		12 UE
MWST051R1	1,3-Dichlorobenzene	Internal Standard	4.0 UE
	1,4-Dichlorobenzene		4.0 UE
	1,2-Dichlorobenzene		4.0 UE
	1,2,4-Trichlorobenzene		10 UE
MWST047R1	1,3-Dichlorobenzene	Internal Standard	5.3 UE
	1,4-Dichlorobenzene		5.3 UE
	1,2-Dichlorobenzene		5.3 UE
	1,2,4-Trichlorobenzene		13 UE

Discussion: The internal standard 1,4-Dichlorobenzene-d_4 was out of criteria for Sample Nos. MWST044R1, MWST047R1, and MWST051R1. The associated compounds have been flagged with "E" or "UE" for estimated. Sample Nos. MWST044R1RE, MWST051R1RE, and MWST047R1RE were also affected by

internal standards that are out of criteria, but are flagged "R" elsewhere in this report.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analytes Affected	Type of Deviation	Flag
MWST051R1RE	All	Excessive Dilution	R
MWST047R1RE	All	Excessive Dilution	R
MWST044R1RE	All	Excessive Dilution	R

Discussion: Two samples were diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution. To condense the results to one result per analyte per sample, the results that are above the calibration range or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data for samples that are flagged with an "R" are not acceptable for use. The analyses were not within the requirements of the referenced method and significant discrepancies were observed between raw data and reported data results.

For the other samples, the data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Several continuing calibration checks were out of criteria for various dates of analysis. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from a different analytical run that had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, Phenol, and bis(2-Ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Several samples and quality control check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST044R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	5.2 E 1500 E
MWST047R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	9.7 E 1200 E
MWST051R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	9.0 E 15000 E

Discussion: Benzyl Alcohol and Pyrene were out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pairs associated with Samples No. MWST044R1, MWST047R1, and MWST051R1, which have been flagged as "E" for estimated.

Several other analytes were out of criteria for a single blank spike or matrix spike but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) were acceptable, and/or the percent recovery was within QAPP criteria. No additional data qualifier flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples in several SDGs for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column that had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for three Continuing Calibration Verification standards were out of criteria, but no data flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: Although there is no acceptance criteria listed in the QAPP, the reviewer considered the percent recovery of Hexachlorobutadiene to be low at 38 % and 42% recovery for the MS/MSD pair. Because the Blank Spike and Blank Spike Duplicate were acceptable, only the sample used for the matrix spike (which was in a different SDG) was flagged for this analyte, and no other data qualifier flags are recommended for the other samples in the batch.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl on a Continuing Calibration Verification standard was out of criteria, but no data flags are recommended because this result is a QC check and all surrogates for the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting levels.

Discussion: Copper was detected in the method blank associated with Sample Nos. MWST044R1 and MWST051R1. No data qualifier flags are recommended because the concentration of copper in the samples was at least ten times greater than the concentration of copper in the blank.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST044R1	Mercury	MS/MSD	2.6 E
MWST047R1	Mercury	MS/MSD	1.7 E
MWST051R1	Mercury	MS/MSD	0.92 E

Discussion: Mercury was out of criteria for both accuracy and precision MS/MSD pair. Samples No. MWST044R1, MWST047R1 and MWST051R1 have been flagged as "E" for estimated.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Sulfide, Ammonia, TOC and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The concentration of the spiking compound for Total Organic Carbon was less than the concentration of the sample. No data qualifier flags are recommended because the percent recovery was within criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Quality By Design

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
346	MWST044R1	805082-1	8260	49	1,3-Dichlorobenzene	4.9	UE	Internal Standard
346	MWST044R1	805082-1	8260	50	1,4-Dichlorobenzene	4.9	UE	Internal Standard
346	MWST044R1	805082-1	8260	47	1,2-Dichlorobenzene	4.9	UE	Internal Standard
346	MWST044R1	805082-1	8260	38	1,2,4-Trichlorobenzene	12	UE	Internal Standard
346	MWST044R1RE	805082-1 RE	8260	40	Tetrachloroethene	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	39	Ethylbenzene	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	53	(m+p)-Xylenes	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	41	o-Xylene	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	49	1,3-Dichlorobenzene	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	50	1,4-Dichlorobenzene	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	47	1,2-Dichlorobenzene	9.8	UR	Excessive Dilution
346	MWST044R1RE	805082-1 RE	8260	38	1,2,4-Trichlorobenzene	24	UR	Excessive Dilution
352	MWST047R1	805082-2	8260	49	1,3-Dichlorobenzene	5.3	UE	Internal Standard
352	MWST047R1	805082-2	8260	50	1,4-Dichlorobenzene	5.3	UE	Internal Standard
352	MWST047R1	805082-2	8260	47	1,2-Dichlorobenzene	5.3	UE	Internal Standard
352	MWST047R1	805082-2	8260	38	1,2,4-Trichlorobenzene	13	UE	Internal Standard
352	MWST047R1RE	805082-2 RE	8260	40	Tetrachloroethene	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	39	Ethylbenzene	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	53	(m+p)-Xylenes	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	41	o-Xylene	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	49	1,3-Dichlorobenzene	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	50	1,4-Dichlorobenzene	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	47	1,2-Dichlorobenzene	9.6	UR	Excessive Dilution
352	MWST047R1RE	805082-2 RE	8260	38	1,2,4-Trichlorobenzene	24	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	40	Tetrachloroethene	10	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	39	Ethylbenzene	10	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	53	(m+p)-Xylenes	10	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	41	o-Xylene	10	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	49	1,3-Dichlorobenzene	10.0	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	50	1,4-Dichlorobenzene	10.0	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	47	1,2-Dichlorobenzene	10.0	UR	Excessive Dilution
365	MWST051R1RE	805082-3 RE	8260	38	1,2,4-Trichlorobenzene	25	UR	Excessive Dilution
346	MWST044R1	805082-1	8270	7	Benzyl Alcohol	5.2	E	MS/MSD & BS/BSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
346	MWST044R1	805082-1	8270	26	Pyrene	1500	E	MS/MSD & BS/BSD
352	MWST047R1	805082-2	8270	7	Benzyl Alcohol	9.7	E	MS/MSD & BS/BSD
352	MWST047R1	805082-2	8270	26	Pyrene	1200	E	MS/MSD & BS/BSD
365	MWST051R1	805082-3	8270	7	Benzyl Alcohol	9.0	E	MS/MSD & BS/BSD
365	MWST051R1	805082-3	8270	26	Pyrene	15000	E	MS/MSD & BS/BSD
346	MWST044R1	805082-1	7471	59	Mercury	2.6	E	MS/MSD
365	MWST047R1	805082-2	7471	59	Mercury	1.7	E	MS/MSD
365	MWST051R1	805082-3	7471	59	Mercury	0.92	E	MS/MSD

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805082

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 3

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	M	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	M	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	M	M	O	O	M	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved internal standards associated with several Dichlorobenzenes. Benzyl Alcohol, Pyrene, and Mercury were qualified due to MS/MSD and BS/BSD failures.

DATA EVALUATION SUMMARY

SDG No. 805082

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 3

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA						8		8	8/48 =	16.7%
SVOA					6			6	6/21 =	28.6%
PEST								0	0/15 =	0%
PCB								0	0/21 =	0%
METALS					3			3	3/69 =	4.3%
INORG								0	0/21 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA							24	24	24/48 =	50.0%
SVOA								0	0/21 =	0%
PEST								0	0/15 =	0%
PCB								0	0/21 =	0%
METALS								0	0/69 =	0%
INORG								0	0/21 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling:
SDG No. 805090

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

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This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, as revised, 1994; *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, 1994; and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997; or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWCT041R2	805090-1	X	X	X	X	X	X	
MWCT046R2	805090-2	X	X	X	X	X	X	
MWCT050R2	805090-3	X	X	X	X	X	X	
MWCT053R2	805090-4	X	X	X	X	X	X	
MWSS055R1	805090-5	X	X	X	X	X	X	
MWSS026R1	805090-6	X	X	X	X	X	X	
MWSS026S1	805090-7	X	X	X	X	X	X	
MWSS026T1	805090-8	X						

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer, and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	239 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	568 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	242 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	210 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	181 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	43 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	20 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	8 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: There were changes and obliterations on the chain-of-custody with no initials and date.

There is a five day break in Chain-of-Custody from the time the samples were relinquished by MultiChem Analytical Services and when Columbia Analytical Services received the samples into the laboratory. There were no bills of lading or airbills to indicate a courier service was used.

Foster Wheeler has investigated this issue and noted that the samples were packaged on Friday but not shipped until Monday, at which point they were shipped via standard delivery and not by express. The sample shipping codes are on file with MultiChem and Federal Express. No further action is required.

Columbia Analytical Services did not provide any information regarding sample condition upon receipt. Foster Wheeler has investigated this issue and Columbia Analytical Services is providing the appropriate documentation directly to Foster Wheeler. Foster Wheeler has provided the reviewer with a written statement that the sample temperature upon receipt was 4.3°C, which is within the recommended range of 4 ± 2°C.

There is a five hour break in Chain-of-Custody from the time the samples were relinquished by MultiChem Analytical Services and when Rosa Environmental and Geotechnical Laboratory, LLC received the samples. It is noted on the Chain-of-Custody that the samples were sent via a courier.

The samples were received at Rosa Environmental and Geotechnical Laboratory, LLC in a cardboard box and the Chain-of-Custody notes that the samples were cool, not cold. No data qualifier flags are recommended since temperature does not affect grain size.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: The date of sample collection is missing on Form I for Sample No. MWSS026T1 (Trip Blank). The laboratory has been contacted and has been requested to revise the page and reissue the corrected page directly to Foster Wheeler.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for Toluene-d_8 in Sample No. MWSS055R1 was out of criteria, but per Functional Guidelines, no data flags are required unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

Sample Nos. MWSS026R1 and MWSS026S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCT046R2	1,3-Dichlorobenzene	Internal Standard	3.8 UE
	1,4-Dichlorobenzene		3.8 UE
	1,2-Dichlorobenzene		3.8 UE
	1,2,4-Trichlorobenzene		9.6UE

Discussion: The internal standard 1,4-Dichlorobenzene-d_4 was out of criteria for Sample No. MWCT046R2. The associated compounds have been flagged with "E" or "UE" for estimated. Sample No. MWCT046R2RE was also affected by internal standards that are out of criteria, but is flagged "R" elsewhere in this report.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST046R2RE	All	Excessive Dilution	R

Discussion: One sample was diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution. To condense the results to one result per analyte per sample, the results that are above the calibration range or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

All TIC calculations, spectra, and library searches were reviewed and met the criteria of the referenced method. No TICs were detected in the laboratory blanks.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephone Kim Lofgren of MultiChem Analytical Services to request that the sample date be added to Form 1 for Sample No. MWSS026T1 and send the revised

report to Foster Wheeler directly. This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data for samples that are flagged with an "R" are not acceptable for use. The analyses were not within the requirements of the referenced method and significant discrepancies were observed between raw data and reported data results. However, those compounds that were flagged "R," were re-analyses of the samples. All samples still have reported values for each analyte.

For the other samples, the data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Several continuing calibration checks were out of criteria for various dates of analysis. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from a different analytical run that had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, Phenol, and bis(2-Ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Several samples had surrogates that were out of criteria on the concentrated re-analysis for n-Nitrosodiphenylamine, but were acceptable in the initial analysis, and no data qualifier flags are recommended.

Several samples and quality control check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCT041R2	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	5.6 E 2000 E
MWCT046R2	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	6.2 E 1400 E
MWCT050R2	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	3.2 E 10000 E
MWCT053R2	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	3.2 E 1400 E
MWCT055R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	6.9 E 2200 E
MWCT026R1	Benzyl Alcohol	MS/MSD & BS/BSD	2.5 E

Associated Samples	Analyte Affected	Type of Deviation	Flag
	Pyrene		1600 E
MWCT026S1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	2.2 E 1200 E

Discussion: Benzyl Alcohol and Pyrene were out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pairs associated with Samples No. MWCT041R2, MWCT046R2, MWCT050R2, MWCT053R2, MWCT055R1, MWCT026R1 and MWCT026S1, which have been flagged as "E" for estimated.

Several other analytes were out of criteria for a single blank spike or matrix spike but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) were acceptable, and/or the percent recovery was within QAPP criteria. No additional data qualifier flags are recommended.

7. Field Duplicates

Sample Nos. MWSS026R1 and MWSS026S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWSS026R1 Initial Result	MWSS026S1 Duplicate Result	RPD
Phenol	120	66	58.1
Benzyl Alcohol	2.5	2.2	12.8
2-Methylphenol	6.8	6.6	3.0
4-Methylphenol	130	78	50.0
2,4-Dimethylphenol	8.2	10	19.8
Benzoic Acid	70	56	22.2
Pentachlorophenol	2.4	2.3	4.3
Mean RPD, Acid Fraction			**24.3**
Standard Deviation			**21.7**
Naphthalene	780	380	69.0

Analyte	MWSS026R1 Initial Result	MWSS026S1 Duplicate Result	RPD
2-Methylnaphthalene	280	120	80.0
Acenaphthylene	210	150	33.3
Acenaphthene	200	100	66.7
Dibenzofuran	220	160	31.6
Fluorene	310	230	29.6
Phenanthrene	960	720	28.6
Anthracene	420	310	30.1
Fluoranthene	1100	860	24.5
Pyrene	1600	1200	28.6
Benzo(a)anthracene	520	440	16.7
Chrysene	590	520	12.6
bis(2-Ethylhexyl)phthalate	130	43	100.6
Benzo(b)fluoranthene	890	990	10.6
Benzo(k)fluoranthene	890	990	10.6
Benzo(a)pyrene	590	550	7.0
Indeno(1,2,3-cd)pyrene	260	170	41.9
Benzo(g,h,i)perylene	300	180	50.0
Mean RPD, B/N Fraction			**37.3**
Standard Deviation of the Mean RPD			**26.3**

Key:
ND = Not Detected NC = Not Calculable

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples in several SDGs for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal

standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

All TIC calculations, spectra, and library searches were reviewed and met the criteria of the referenced method. No TICs were detected in the laboratory blanks.

Discussion: In Sample No. MWCT053R2, tentatively identified compounds were reported. As required by Functional Guidelines, all TIC results have already been flagged with "NJ" for tentatively identified with estimated concentration by the laboratory.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because both the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column that had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for three Continuing Calibration Verification standards were out of criteria, but no data flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWSS026R1 and MWSS026S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCS055R1	4,4'-DDT	Calculation Error	11.4

Discussion: The laboratory noted that the positive hit for 4,4'-DDT on Sample No. MWSS055R1 exceeded the CLP criteria of 25% difference for quantitation on

two columns. The laboratory has reported the lower of the two results and has already flagged the results. EPA Method 8000B recommends that the higher of the two results be reported and the value reported is revised to the greater value.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl on a Continuing Calibration Verification standard was out of criteria, but no data flags are recommended because this result is a QC check and all surrogates for the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWSS026R1 and MWSS026S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution. or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting levels.

Discussion: Copper was detected in the method blank associated with all the samples in this SDG. No data qualifier flags are recommended because the concentration of copper in the samples was at least ten times greater than the concentration of copper in the blank.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCT041R2	Mercury	MS/MSD	0.92 E
MWCT046R2	Mercury	MS/MSD	0.98 E
MWCT050R2	Mercury	MS/MSD	0.34 E
MWCT053R2	Mercury	MS/MSD	0.15 UE
MWSS055R1	Mercury	MS/MSD	2.9 E
MWSS026R1	Mercury	MS/MSD	0.41 E
MWSS026S1	Mercury	MS/MSD	0.48 E

Discussion: Mercury was out of criteria for both accuracy and precision MS/MSD pair. Samples No. MWCT041R2, MWCT046R2, MWCT050R2, MWCT053R2, MWSS026R1, MWSS026S1 and MWSS055R1 have been flagged as "E" for estimated.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis was performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

Sample Nos. MWSS026R1 and MWSS026S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data

validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWSS026R1 Initial Result	MWSS026S1 Duplicate Result	RPD
Antimony	15.6	26.2	50.7
Arsenic	70.0	194	93.9
Cadmium	0.68	0.70	2.9
Copper	159	157	1.3
Lead	88.9	92.0	3.4
Mercury	0.41	0.48	15.7
Nickel	15.0	12.1	21.4
Zinc	423	440	3.9
Mean RPD			**24.2**
Standard Deviation			**32.7**

Key:
ND = Not Detected NC = Not Calculable

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The concentration of Total Organic Carbon in the sample was greater than the spiking concentration for the matrix spike. No data qualifier flags are recommended because the percent recovery was within criteria.

6. Field Duplicates

Sample Nos. MWSS026R1 and MWSS026S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	**MWSS026R1 Initial Result**	**MWSS026S1 Duplicate Result**	**RPD**
Total Organic Carbon	24400	30800	23.2
Percent Moisture (Multichem Lab)	38	36	5.4
Total Solids (CAS Lab)	69.0	66.8	3.2
Ammonia	6.1	11.8	63.7
Sulfide	148.0	80.1	59.5
Mean RPD			**31.0**
Standard Deviation of the Mean RPD			**29.0**

Key:
ND = Not Detected NC = Not Calculable

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWCT050R2	Total Fines	Calculation Error	64.9
MWSS055R1	Total Fines	Calculation Error	69.8

Calculation errors were found in determining the final results. Corrected values are listed in the summary table and on the laboratory final report forms.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
350	MWCT046R2	805090-2	8260	49	1,3-Dichlorobenzene	3.8	UE	Internal Standard
350	MWCT046R2	805090-2	8260	50	1,4-Dichlorobenzene	3.8	UE	Internal Standard
350	MWCT046R2	805090-2	8260	47	1,2-Dichlorobenzene	3.8	UE	Internal Standard
350	MWCT046R2	805090-2	8260	38	1,2,4-Trichlorobenzene	9.6	UE	Internal Standard
350	MWCT046R2RE	805090-2 RE	8260	40	Tetrachloroethene	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	39	Ethylbenzene	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	53	(m+p)-Xylenes	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	41	o-Xylene	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	49	1,3-Dichlorobenzene	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	50	1,4-Dichlorobenzene	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	47	1,2-Dichlorobenzene	9.6	UR	Excessive Dilution
350	MWCT046R2RE	805090-2 RE	8260	38	1,2,4-Trichlorobenzene	24	UR	Excessive Dilution
374	MWSS055R1 RE	805090-5RE	8260	40	Tetrachloroethene	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	39	Ethylbenzene	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	53	(m+p)-Xylenes	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	41	o-Xylene	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	49	1,3-Dichlorobenzene	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	50	1,4-Dichlorobenzene	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	47	1,2-Dichlorobenzene	8.5	UR	Duplicate Analysis
374	MWSS055R1 RE	805090-5RE	8260	38	1,2,4-Trichlorobenzene	21	UR	Duplicate Analysis
342	MWCT041R2	805090-1	8270	7	Benzyl Alcohol	5.6	E	MS/MSD & BS/BSD
342	MWCT041R2	805090-1	8270	26	Pyrene	2000	E	MS/MSD & BS/BSD
350	MWCT046R2	805090-2	8270	7	Benzyl Alcohol	6.2	E	MS/MSD & BS/BSD
350	MWCT046R2	805090-2	8270	26	Pyrene	1400	E	MS/MSD & BS/BSD
364	MWCT050R2	805090-3	8270	7	Benzyl Alcohol	3.2	E	MS/MSD & BS/BSD
364	MWCT050R2	805090-3	8270	26	Pyrene	10000	E	MS/MSD & BS/BSD
369	MWCT053R2	805090-4	8270	7	Benzyl Alcohol	3.2	E	MS/MSD & BS/BSD
369	MWCT053R2	805090-4	8270	26	Pyrene	1400	E	MS/MSD & BS/BSD
374	MWSS055R1	805090-5	8270	7	Benzyl Alcohol	6.9	E	MS/MSD & BS/BSD
374	MWSS055R1	805090-5	8270	26	Pyrene	2200	E	MS/MSD & BS/BSD
298	MWSS026R1	805090-6	8270	7	Benzyl Alcohol	2.5	E	MS/MSD & BS/BSD
298	MWSS026R1	805090-6	8270	26	Pyrene	1600	E	MS/MSD & BS/BSD
298	MWSS026S1	805090-7	8270	7	Benzyl Alcohol	2.2	E	MS/MSD & BS/BSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
298	MWSS026S1	805090-7	8270	26	Pyrene	1200	E	MS/MSD & BS/BSD
374	MWSS055R1	805090-5	8081	34	4,4'-DDT	11.4		Calculation Error
342	MWCT041R2	805090-1	7471	59	Mercury	0.92	E	MS/MSD
350	MWCT046R2	805090-2	7471	59	Mercury	0.98	E	MS/MSD
364	MWCT050R2	805090-3	7471	59	Mercury	0.34	E	MS/MSD
369	MWCT053R2	805090-4	7471	59	Mercury	0.15	UE	MS/MSD
374	MWSS055R1	805090-5	7471	59	Mercury	2.9	E	MS/MSD
298	MWSS026R1	805090-6	7471	59	Mercury	0.41	E	MS/MSD
298	MWSS026S1	805090-7	7471	59	Mercury	0.48	E	MS/MSD
364	MWCT050R2	805090-3	ASTM422M	79	Percent Fines	64.9		Calculation Error
298	MWSS055R1	805090-6	ASTM422M	79	Percent Fines	69.8		Calculation Error

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805090

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 8

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	N/A
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	M	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	M	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	M	M	O	O	M	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved internal standards associated with several Dichlorobenzenes and MS/MSD and BS/BSD failures for Benzyl Alcohol, Pyrene, and Mercury. A single value for 4,4'-DDT was revised due a calculation error.

DATA EVALUATION SUMMARY

SDG No. 805090

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 8

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA						4		4	4/64 =	6.2%
SVOA					14			14	14/49 =	28.6%
PEST							1**	1	1/35 =	2.9%
PCB								0	0/49 =	0%
METALS					7			7	7/161 =	4.3%
INORG								0	0/49 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA							16	16	16/64 =	25.0%
SVOA								0	0/49 =	0%
PEST								0	0/35 =	0%
PCB								0	0/49 =	0%
METALS								0	0/161 =	0%
INORG								0	0/49 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 22, 1998
SDG No. 805096

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved.

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal — Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction

Laboratory Sciences, Inc., dba *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWRM201R1	805096-1	X	X	X	X	X	X	
MWRM202R1	805096-2	X	X	X	X	X	X	
MWST042R1	805096-3	X	X	X	X	X	X	
MWRM201T1	805096-4	X						

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	147 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	404 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	202 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	202 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	231 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	39 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	15 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	4 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The Chain-of-Custody contains a gap in custody of about 24 hours, presumably for shipping from MAS to CAS. The waybills are not attached and neither lab noted that the samples were relinquished or received from a freight carrier.

Foster Wheeler has investigated this issue and the sample shipping codes are on file with Multichem and Federal Express. No further action is required.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Form I for Sample No. MWRM201T1 does not show when the sample was taken. The laboratory has been contacted to revise the Form to reflect the sample date and reissue the revised page directly to Foster Wheeler.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Several continuing calibration checks were out of criteria for various dates of analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from a different analytical run that had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, Phenol, and Bis(2-ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Several samples and quality control check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWRM201R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	2.1 E 95 E
MWRM202R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	3.2 E 100 E
MWST042R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	6.0 E 870 E

Discussion: Benzyl Alcohol and Pyrene were out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pairs associated with Samples No. MWRM201R1, MWRM202R1, and MWST042R1, which have been flagged as "E" for estimated.

Several other analytes were out of criteria for a single blank spike or matrix spike but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) were acceptable, and/or the percent recovery was within QAPP criteria. No additional data qualifier flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples in several SDGs for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column which had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for three Continuing Calibration Verification standards were out of criteria, but no data flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: Although there is no acceptance criteria listed in the QAPP, the reviewer considered the percent recovery of Hexachlorobutadiene to be low at 38 % and 42% recovery for the MS/MSD pair. Because the Blank Spike and Blank Spike Duplicate were acceptable, only the sample used for the matrix spike (which was in a different SDG) was flagged for this analyte, and no other data qualifier flags are recommended for the other samples in the batch.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl on a Continuing Calibration Verification standard was out of criteria, but no data flags are recommended because this result is a QC check and all surrogates for the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting levels.

Discussion: Zinc was detected in the method blank analyzed with the Samples No. MWRM201R1 and MWST202R1. No data qualifier flags are recommended because the concentration of the analytes in the samples is at least ten times greater than the concentration in the blanks.

Copper was detected in the method blank analyzed with Sample No. MWRM201R1, MWST202R1 and MWST042R1. No data qualifier flags are recommended because the concentration of the analyte in the samples is at least ten times greater than the concentration in the blank.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWRM201R1	Mercury	MS/MSD	0.17 UE
MWRM202R1	Mercury	MS/MSD	0.42 E
MWST042R1	Mercury	MS/MSD	1.0 E

Discussion: Mercury was out of criteria for both accuracy and precision and MS/MSD. Samples No. MWRM201R1, MWRM202R1 and MWST042R1 have been flagged as "E" or "UE" for estimated.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWRM202R1	Total Fines	Calculation Error	53.8

Discussion: Calculation errors were found in determining the final results for Total fines in Sample No. MWRM202R1. The correct value should be 53.8. Corrected values are listed in the summary table and on the laboratory final report forms.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data. as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
254	MWRM201R1	805096-1	8270	7	Benzyl Alcohol	2.1	E	MS/MSD & BS/BSD
254	MWRM201R1	805096-1	8270	26	Pyrene	95	E	MS/MSD & BS/BSD
256	MWRM202R1	805096-2	8270	7	Benzyl Alcohol	3.2	E	MS/MSD & BS/BSD
256	MWRM202R1	805096-2	8270	26	Pyrene	100	E	MS/MSD & BS/BSD
343	MWST042R1	805096-3	8270	7	Benzyl Alcohol	6.0	E	MS/MSD & BS/BSD
343	MWST042R1	805096-3	8270	26	Pyrene	870	E	MS/MSD & BS/BSD
254	MWRM201R1	805096-1	7471	59	Mercury	0.17	E	MS/MSD
256	MWRM202R1	805096-2	7471	59	Mercury	0.42	E	MS/MSD
343	MWST042R1	805096-3	7471	59	Mercury	1.0	E	MS/MSD
256	MWRM202R1	805096-2	ASTM422M	79	Percent Fines	53.8		Calculation Error

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

SDG No.: 805096

Method: PSEP

No. of Samples: 4

Reviewer: Quality by Design

Laboratory: MultiChem Analytical Service

Data Use: Foster Wheeler Environmental Corp.

Review Completion Data: October 14, 1998

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	N/A
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	M	O	O	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol, Pyrene, and Mercury.

DATA EVALUATION SUMMARY

SDG No. 805096

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 4

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples	
VOA								0	0/32 =	0%
SVOA					6			6	6/21 =	28.6%
PEST								0	0/15 =	0%
PCB								0	0/21 =	0%
METALS					3			3	3/69 =	4.3%
INORG							1**	10	1/21 =	4.8%

Note Asterisk (*) indicates additional exceedances of review criteria ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standard	Other	Total # of Analytes	Total # Rejected/Total # in all Samples	
VOA							134	134	0/32 =	0%
SVOA								0	0/21 =	0%
PEST								0	0/15 =	0%
PCB								0	0/21 =	0%
METALS								0	0/69 =	0%
INORG								0	0/21 =	0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 22, 1998
SDG No. 805097

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/19/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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B. Chain-of-Custody and Sample Receipt 4
C. Review of Inorganic Analyses 5

Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualifier Summary
Attachment 3 Data Evaluation Summary
Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., dba *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The size of the data packages, the data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWRC208R1	805097-1						X	
MWRC209R1	805097-2						X	
MWRC210R1	805097-3						X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Inorganics	Sediment	15 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	16 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	2 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors were found.

C. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Calibration

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Associated Samples	Analyte	Type of Deviation	Flag
MWRC209R1	Total Fines	Calculation Error	53.4

Calculation errors were found in determining the final results for Total Fines. Corrected values are listed in the summary table and on the laboratory final report forms.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
404	MWRC209R1	805097-2	ASTM422M	79	Percent Fines	53.4		Calculation Error

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805097

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 3

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	N/A	N/A	N/A	N/A	N/A	O	N/A
GC/MS Performance	N/A	N/A	N/A	N/A	N/A	O	N/A
Initial & Continuing Calibration	N/A	N/A	N/A	N/A	N/A	O	N/A
Field Blanks (F=N/A)	N/A	N/A	N/A	N/A	N/A	F	N/A
Laboratory Blanks	N/A	N/A	N/A	N/A	N/A	O	N/A
Surrogates	N/A	N/A	N/A	N/A	N/A	O	N/A
Matrix Spikes/Duplicates	N/A	N/A	N/A	N/A	N/A	O	N/A
QC Samples (LCS, PVS)	N/A	N/A	N/A	N/A	N/A	O	N/A
Internal Standards	N/A	N/A	N/A	N/A	N/A	O	N/A
Compound Identification	N/A	N/A	N/A	N/A	N/A	O	N/A
Compound Quantification	N/A	N/A	N/A	N/A	N/A	X	N/A
System Performance	N/A	N/A	N/A	N/A	N/A	O	N/A
Overall Assessment	N/A	N/A	N/A	N/A	N/A	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: A single value for grain size was revised due to a calculation error.

DATA EVALUATION SUMMARY

SDG No. 805097

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 3

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
INORG							1**	1	1/21 = 4.8%

Note Asterisk (*) indicates additional exceedances of review criteria ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
INORG								0	0/21 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 26, 1998
SDG No. 805102

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis, Principal — Date: 10/14/98

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
Attachment 3 Data Evaluation Summary
Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., dba. *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWRH205R1	805102-1	X	X	X	X	X	X	
MWRH206R1	805102-2	X	X	X	X	X	X	
MWRH207R1	805102-3	X	X	X	X	X	X	
Trip Blank	805102-4	X						

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, Grain Size
TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediment	150 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	416 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	223 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	202 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	138 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	41 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	18 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	4 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors were found.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Discussion: Several continuing calibration checks were out of criteria for various dates of analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from a different analytical run that had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, Phenol, and Bis(2-ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Several samples and quality control check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWRH205R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	24 UE 290 E
MWRH206R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	28 UE 430 E
MWRH207R1	Benzyl Alcohol Pyrene	MS/MSD & BS/BSD	53 UE 400 E

Discussion: Benzyl Alcohol and Pyrene were out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pairs associated with Samples No. MWRH205R1, MWRH206R1, and MWRH207R1, which have been flagged as "E" or "UE" for estimated.

Several other analytes were out of criteria for a single blank spike or matrix spike but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) were acceptable, and/or the percent

recovery was within QAPP criteria. No additional data qualifier flags are recommended.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples in several SDGs for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RSD) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria at several times during the analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated samples were non-detect, or all quantitation was performed from the second column which had acceptable results.

3. Blanks and Checks for Calibration

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate (Decachlorobiphenyl) on Sample No. MWRH207R1 was out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Calibration

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate (Decachlorobiphenyl) on Sample No. MWRH207R1 was out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWRH205R1	Aroclor 1254	False High Result	81 L
MWRH205R1	Total PCBs	False High Result	81 L
MWRH206R1	Aroclor 1254	False High Result	98 L
MWRH206R1	Total PCBs	False High Result	98 L
MWRH207R1	Aroclor 1254	False High Result	126 L
MWRH207R1	Total PCBs	False High Result	126 L

Discussion: In addition to measurable levels of Aroclor 1254, all of the samples in this Sample Delivery Group contain trace levels of Aroclor 1248 and 1260, each of which was detected but at less than the reporting limit. It is difficult to differentiate the

overlapping peaks from these trace amounts to the concentrations reported for Aroclor 1254. The reviewer concurs that Aroclor 1254 is present, but that the quantitation may be elevated due to contributions from the other Aroclors, and on three samples, the results are flagged "L" to indicate that the value is less than the maximum shown.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: The Cover Page IN for SDG 805102 is incorrect. The laboratory has been contacted to revise and resubmit the corrected page directly to Foster Wheeler.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting levels.

Discussion: Copper and Zinc were detected in the method blank associated with this SDG. No data qualifier flags are recommended because the concentration of the analytes in the samples are at least ten times the concentration found in the blanks.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWRH205R1	Mercury	MS/MSD	0.18 UE
MWRH206R1	Mercury	MS/MSD	0.22 UE
MWRH207R1	Mercury	MS/MSD	0.24 UE

Discussion: Matrix spike and matrix spike duplicate recoveries were out of criteria due to high concentrations of analytes in the original sample. The laboratory has already flagged the data appropriately with "N" to indicate the recovery was out of criteria. An additional data qualifier flag of "UE" for estimated reporting limit has been added.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process so that the QBD project manager could request that the Cover Page-IN be revised and resubmitted. This was followed up by fax notes, copies of which are appended to this validation report.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
251	MWRH205R1	805102-1	8270	7	Benzyl Alcohol	24	UE	MS/MSD & BS/BSD
251	MWRH205R1	805102-1	8270	26	Pyrene	290	E	MS/MSD & BS/BSD
252	MWRH206R1	805102-2	8270	7	Benzyl Alcohol	28	UE	MS/MSD & BS/BSD
252	MWRH206R1	805102-2	8270	26	Pyrene	430	E	MS/MSD & BS/BSD
253	MWRH207R1	805102-3	8270	7	Benzyl Alcohol	53	UE	MS/MSD & BS/BSD
253	MWRH207R1	805102-3	8270	26	Pyrene	400	E	MS/MSD & BS/BSD
251	MWRH205R1	805102-1	8082	66	Aroclor 1254	81	L	False High Result
251	MWRH205R1	805102-1	8082	46	PCB Total	81	L	False High Result
252	MWRH206R1	805102-2	8082	66	Aroclor 1254	98	L	False High Result
252	MWRH206R1	805102-2	8082	46	PCB Total	98	L	False High Result
253	MWRH207R1	805102-3	8082	66	Aroclor 1254	126	L	False High Result
253	MWRH207R1	805102-3	8082	46	PCB Total	126	L	False High Result
251	MWRH205R1	805102-1	7471	59	Mercury	0.18	UE	MS/MSD
252	MWRH206R1	805102-2	7471	59	Mercury	0.22	UE	MS/MSD
253	MWRH207R1	805102-3	7471	59	Mercury	0.24	UE	MS/MSD

Attachment 3
Data Evaluation

DATA EVALUATION SUMMARY

SDG No. 805102

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 4

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA								0	0/32 = 0%
SVOA					6			6	6/21 = 28.6%
PEST								0	0/15 = 0%
PCB							6	6	6/21 = 28.6%
METALS					3			3	3/69 = 4.3%
INORG								0	0/21 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/32 = 0%
SVOA								0	0/21 = 0%
PEST								0	0/15 = 0%
PCB								0	0/21 = 0%
METALS								0	0/69 = 0%
INORG								0	0/21 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805102

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 4

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	N/A
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	X	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	M	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	M	O	M	X	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol, Pyrene, and Mercury. Several PCB values were considered to have false high values due to the quantitation of Aroclor mixtures.

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 27, 1998
SDG No. 805108

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal — Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
Attachment 3 Data Evaluation Summary
Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., dba *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWSB11bR1	805108-1	X	X	X	X	X	X	
MWSB10aR1	805108-2	X	X	X	X	X	X	
MWSB10bR1	805108-3	X	X	X	X	X	X	
MWSB10cR1	805108-4	X	X	X	X	X	X	
MWSB11aR1SP	805108-5	X	X	X	X	X	X	
MWSB10aT1	805108-6	X						
MWSB014R1	805108-7	X	X	X	X	X	X	
MWSB013R1	805108-8	X	X	X	X	X	X	
MWSB012R1	805108-9	X	X	X	X	X	X	
MWSB11aR1	805108-10	X	X	X	X	X	X	
MWSB008R1	805108-11	X	X	X	X	X	X	
MWSB008S1	805108-12	X	X	X	X	X	X	
MWSB014T1	805108-13	X						

Key:
- VOA = Volatile Organic Compounds
- SV = Semi-volatile Organic Compounds
- PEST = Chlorinated Pesticides
- PCB = Polychlorinated Biphenyls
- MET = Trace Metals
- INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
- TBT = Tributyl Tin

Table 2: Data, Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	182 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Sediment	960 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	302 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	247 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	291 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	96 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	31 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Sediment	8 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: There were obliterations and/or changes made on the Chain-of-Custody without initials or dates.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

Sample Nos. MWSB008R1 and MWSB008S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Within the initial fourteen day holding time, the laboratory had extracted Sample No. MWSB10aR1, but lost the extract. At the time of extraction, the laboratory had also frozen a portion of the sample. This frozen aliquot was thawed and re-analyzed after fourteen days had elapsed. Because PSEP recommendations list a one year holding time for frozen sediments for this analysis, the holding time was not exceeded.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB014R1	Pentachlorophenol	Continuing Calibration	6.2 E
MWSB013R1	Pentachlorophenol	Continuing Calibration	6.8 E
MWSB012R1	Pentachlorophenol	Continuing Calibration	39 E
MWSB11aR1	Pentachlorophenol	Continuing Calibration	19 E
MWSB008R1	Pentachlorophenol	Continuing Calibration	100 E

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB008S1	Pentachlorophenol	Continuing Calibration	73 E
MWSB10bR1	Indeno(1,2,3-cd)pyrene	Continuing Calibration	471 E
	Dibenzo(a,h)anthracene		14 E
	Benzo(g,h,i)perylene		400 E

Discussion: A continuing calibration check for Pentachlorophenol, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene on June 21, 1998 had percent differences greater than 50%. Except for Pentachlorophenol, there are no method or QAPP requirements for these compounds. However, the professional judgment of the reviewer is that results that are associated with these calibration checks should be flagged "E" or "UE" for estimated.

Several other continuing calibration checks were out of criteria for various dates of analysis. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from a different analytical run that had acceptable results.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Benzoic Acid, Phenol, and Bis(2-ethylhexyl)phthalate was detected in the method blank analyzed with this SDG. The concentration of the compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Sample No. MWSB012R1, MWSB11R1, and some of the QC check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but, per

Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB11bR1	Benzyl Alcohol	MS/MSD & BS/BSD	9.4 E
MWSB10aR1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD & BS/BSD	14 E 18 E
MWSB10bR1	Benzyl Alcohol	MS/MSD & BS/BSD	38 E
MWSB10cR1	Benzyl Alcohol	MS/MSD & BS/BSD	4.9 E
MWSB11aR1 SP	Benzyl Alcohol	MS/MSD & BS/BSD	3.9 E
MWSB014R1	Benzyl Alcohol	MS/MSD & BS/BSD	2.0 E
MWSB013R1	Benzyl Alcohol	MS/MSD & BS/BSD	17 E
MWSB012R1	Benzyl Alcohol	MS/MSD & BS/BSD	2.2 E
MWSB11aR1	Benzyl Alcohol	MS/MSD & BS/BSD	4.7 E
MWSB008R1	Benzyl Alcohol	MS/MSD & BS/BSD	99 E
MWSB008S1	Benzyl Alcohol	MS/MSD & BS/BSD	6.8 E

Discussion: Benzyl Alcohol was out of criteria for both accuracy and precision in all of the MS/MSD and BS/BSD pairs associated with all samples, which have been flagged as "E" for estimated.

Sample No. MWSB10aR1 was re-extracted on June 24, 1998. In the acid fraction, 2,4-Dimethylphenol was out of criteria in the BS/BSD, but the laboratory failed to analyze a MS/MSD pair, and the analyte is flagged "E" for estimated.

Several other analytes were out of criteria for a single blank spike or matrix spike but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) were acceptable, and/or the percent recovery was within QAPP criteria. In one case, the amount spiked was less than four times the original concentration of the sample being spiked. No additional data qualifier flags are recommended.

7. Field Duplicates

Sample Nos. MWSB008R1 and MWST008S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWSB008R1 Initial Result	MWSB008S1 Duplicate Result	RPD
Phenol	62	61	1.6
Benzyl Alcohol	99	6.8	174.3
2-Methylphenol	4.1	3.3	21.6
4-Methylphenol	34	28	19.4
2,4-Dimethylphenol	4.4	4.4	0.0
Benzoic Acid	300	120	85.7
Pentachlorophenol	100	73	31.2
Mean RPD, Acid Fraction			**47.7**
Standard Deviation			**62.7**
Naphthalene	210	170	21.1
2-Methylnaphthalene	99	97	2.0
Acenaphthylene	57	68	17.6
Acenaphthene	54	58	7.1
Dibenzofuran	64	65	1.6
Diethylphthalate	34	42	21.1
Fluorene	58	72	21.5
Phenanthrene	430	510	17.0
Anthracene	100	570	140.3
di-n-Butylphthalate	14	16	13.3
Fluoranthene	510	580	12.8
Pyrene	740	650	12.9
Butylbenzylphthalate	45	41	9.3
Benzo(a)anthracene	260	400	42.4
Chrysene	340	800	80.7
bis(2-Ethylhexyl)phthalate	440	450	2.2
di-n-Octylphthalate	330	420	24.0
Benzo(b)fluoranthene	670	1200	56.7

Analyte	MWSB008R1 Initial Result	MWSB008S1 Duplicate Result	RPD
Benzo(k)fluoranthene	670	1200	56.7
Benzo(a)pyrene	370	600	47.4
Indeno(1,2,3-cd)pyrene	190	290	41.7
Dibenzo(a,h)anthracene	43	18	82.0
Benzo(g,h,i)perylene	230	300	26.4
Mean RPD, B/N Fraction			**33.0**
Standard Deviation			**33.1**

Key:
ND = Not Detected NC = Not Calculable

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples in several SDGs for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(h)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column which had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for three Continuing Calibration Verification standards were out of criteria, but no data flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: Although there is no acceptance criteria listed in the QAPP, the reviewer considered the percent recovery of Hexachlorobutadiene to be low at 38 % and 42% recovery for the MS/MSD pair. Because the Blank Spike and Blank Spike Duplicate were acceptable, only the sample used for the matrix spike (which was in a different SDG) was flagged for this analyte, and no other data qualifier flags are recommended for the other samples in the batch.

6. Field Duplicates

Sample Nos. MWSB008R1 and MWSB008S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB10cR1	4,4'-DDE	Not Confirmed	10 U
	4,4'-DDT		33 U
	4,4'-DDD		13 U
MWSB10bR1	4,4'-DDE	Not Confirmed	7.7 U
	4,4'-DDT		15 U
MWSB11aR1	4,4'-DDT	Not Confirmed	8.4 U
MWSB012R1	4,4'-DDT	Not Confirmed	6.8 U

Discussion: A review of the chromatograms indicated trace levels of analytes in "dirty" samples with a considerable number of extraneous peaks. The reviewer does not concur that 4,4'-DDE, 4,4'-DDT, and 4,4'-DDD were confirmed in Samples No.MWSB10cR1, MWSB10bR1, MWSB11aR1, and MWSB012R1, and the values are revised to non-detect.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for the surrogate Decachlorobiphenyl on a Continuing Calibration Verification standard was out of criteria, but no data flags are recommended because this result is a QC check and all surrogates for the samples are acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

Sample Nos. MWSB008R1 and MWSB008S1 were identified as field duplicates. All analytes reported as non-detect and precision could not be calculated.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB11aR1	Aroclor 1254	Not Confirmed	65 U
MWSB11aR1	Total PCBs	Not Confirmed	65 U

Discussion: A review of the chromatograms indicated trace levels of analytes in "dirty" samples with a considerable number of extraneous peaks. The reviewer does not concur that Aroclor 1254 was confirmed in Sample No. MWSB11aR1, and the value is revised to non-detect.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

F. Review of Metal Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

\A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The RPD of the matrix spike and matrix spike duplicate was out of criteria. The laboratory has already flagged the data appropriately with "*" to indicate the RPD was out of criteria. Since all other quality control checks are in criteria, no data qualifier flags are recommended.

Matrix spike recoveries for Copper and Zinc were below the acceptance criteria. The laboratory performed a post digestion spike which was in criteria. The lab has already flagged the sample with "N" to indicate the matrix spike was out of criteria but the post digestion spike was in criteria. No additional data qualifier flags are recommended.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

Sample Nos. MWSB008R1 and MWSB008S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWSB008R1 Initial Result	MWSB008S1 Duplicate Result	RPD
Arsenic	8.4	12.9	42.3
Copper	127	111	13.4
Lead	103	155	40.3
Mercury	0.39	0.48	20.7
Nickel	24.3	19	24.5
Zinc	121	155	24.6
Mean RPD			**27.6**
Standard Deviation of the Mean RPD			**11.3**

Key:
ND = Not Detected NC = Not Calculable

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The RPD for TOC was out of criteria. The laboratory has already flagged the data with "*" and no additional data qualifier flags are recommended.

6. Field Duplicates

Sample Nos. MWSB008R1 and MWSB008S1 were identified as field duplicates. Test results were reviewed and, where positive results were found, the relative percent difference was calculated. All analytes except for those listed in the table below were reported as Non Detect. Because the person who performed the sampling has information that is unavailable to the data validator, such as sampling conditions or problems with equipment, the client typically performs any flagging and data qualification based upon field duplicates.

Analyte	MWSB008R1 Initial Result	MWSB008S1 Duplicate Result	RPD
Total Organic Carbon	25900	15700	49.0
Percent Moisture (Multichem Lab)	37	50	29.9
Total Solids (CAS Lab)	57.6	49.1	15.9
Ammonia	12.2	5.4	77.3
Sulfide	982	1230	22.4
Mean RPD			**38.9**
Standard Deviation of the Mean RPD			**24.8**

Key:
ND = Not Detected NC = Not Calculable

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB10aR1	Total Fines	Calculation Error	17.4
MWSB11bR1	Total Fines	Calculation Error	12.9
MWSB014R1	Total Fines	Calculation Error	3.7

Discussion: Calculation errors were found in determining the final results for Total Fines. Corrected values are listed in the summary table and on the laboratory final report forms.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
378	MWSB10bR1	805108-3	8270	18	Indeno(1,2,3-cd)pyrene	470	E	Continuing Calibration
378	MWSB10bR1	805108-3	8270	12	Dibenzo(a,h)anthracene	14	E	Continuing Calibration
378	MWSB10bR1	805108-3	8270	4	Benzo(g,h,i)perylene	400	E	Continuing Calibration
269	MWSB014R1	805108-7	8270	22	Pentachlorophenol	6.2	E	Continuing Calibration
268	MWSB013R1	805108-8	8270	22	Pentachlorophenol	6.8	E	Continuing Calibration
267	MWSB012R1	805108-9	8270	22	Pentachlorophenol	39	E	Continuing Calibration
380	MWSB11aR1	805108-10	8270	22	Pentachlorophenol	19	E	Continuing Calibration
259	MWSB008R1	805108-11	8270	22	Pentachlorophenol	100	E	Continuing Calibration
260	MWSB008S1	805108-12	8270	22	Pentachlorophenol	73	E	Continuing Calibration
382	MWSB11bR1	805108-1	8270	7	Benzyl Alcohol	9.4	E	MS/MSD & BS/BSD
376	MWSB10aR1	805108-2	8270	7	Benzyl Alcohol	14	E	MS/MSD & BS/BSD
376	MWSB10aR1	805108-2	8270	68	2,4-Dimethylphenol	18	E	BS/BSD
378	MWSB10bR1	805108-3	8270	7	Benzyl Alcohol	38	E	MS/MSD & BS/BSD
379	MWSB10cR1	805108-4	8270	7	Benzyl Alcohol	4.9	E	MS/MSD & BS/BSD
381	MWSB11aR1SP	805108-5	8270	7	Benzyl Alcohol	3.9	E	MS/MSD & BS/BSD
269	MWSB014R1	805108-7	8270	7	Benzyl Alcohol	2.0	E	MS/MSD & BS/BSD
268	MWSB013R1	805108-8	8270	7	Benzyl Alcohol	17	E	MS/MSD & BS/BSD
267	MWSB012R1	805108-9	8270	7	Benzyl Alcohol	2.2	E	MS/MSD & BS/BSD
380	MWSB11aR1	805108-10	8270	7	Benzyl Alcohol	4.7	E	MS/MSD & BS/BSD
259	MWSB008R1	805108-11	8270	7	Benzyl Alcohol	99	E	MS/MSD & BS/BSD
260	MWSB008S1	805108-12	8270	7	Benzyl Alcohol	6.8	E	MS/MSD & BS/BSD
379	MWSB10cR1	805108-4	8081	33	4,4'-DDE	10	U	Not Confirmed
379	MWSB10cR1	805108-4	8081	34	4,4'-DDT	33	U	Not Confirmed
379	MWSB10cR1	805108-4	8081	32	4,4'-DDD	13	U	Not Confirmed
378	MWSB10bR1	805108-3	8081	33	4,4'-DDE	7.7	U	Not Confirmed
378	MWSB10bR1	805108-3	8081	34	4,4'-DDT	15	U	Not Confirmed
381	MWSB11aR1SP	805108-5	8081	34	4,4'-DDT	8.4	U	Not Confirmed
267	MWSB012R1	805108-9	8081	34	4,4'-DDT	6.8	U	Not Confirmed
380	MWSB11aR1	805108-10	8082	66	Aroclor 1254	65	U	Not Confirmed
380	MWSB11aR1	805108-10	8082	46	PCB Total	65	U	Not Confirmed
376	MWSB10aR1	805108-2	ASTM422M	79	Percent Fines	17.4		Calculation Error
382	MWSB11bR1	805108-1	ASTM422M	79	Percent Fines	12.9		Calculation Error
269	MWSB014R1	805108-7	ASTM422M	79	Percent Fines	3.7		Calculation Error

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

SDG No.: 805108

Method: PSEP

No. of Samples: 13

Reviewer: Quality by Design

Laboratory: MultiChem Analytical Service

Data Use: Foster Wheeler Environmental Corp.

Review Completion Data: October 14, 1998

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	X	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	N/A
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	O	O	N/A
QC Samples (LCS. PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	M	X	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	M	M	X	O	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol and continuing calibration checks for Pentachlorophenol. Several values for PCBs. 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE were revised to nondetect because they were not confirmed.

DATA EVALUATION SUMMARY

SDG No. 805108

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 13

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA								0	0/104 = 0%
SVOA			9		12			21	21/84 = 25.0%
PEST							7**	70	7/60= 11.7%
PCB							2**	20	2/84 = 2.4%
METALS								0	0/276 = 0%
INORG								0	0/84 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standard	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA							0	0	0/104 = 0%
SVOA								0	0/84 = 0%
PEST								0	0/60= 0%
PCB								0	2084 = 0%
METALS								0	0/276 = 0%
INORG								0	0/84 = 0%

Quality By Design

Laboratory Quality Assurance Consulting

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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 28, 1998
SDG No. 805115

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal — Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
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A. Introduction

Laboratory Sciences, Inc., dba *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWSB04aR1	805115-1	X	X	X	X	X	X	
MWSB04bR1SP	805115-2	X	X	X	X	X	X	
MWSB03bR1	805115-3	X	X	X	X	X	X	
MWSB04bR1	805115-4	X	X	X	X	X	X	
MWSB008R1SP	805115-5	X	X	X	X	X	X	
MWSB009R1	805115-6	X	X	X	X	X	X	
MWST045R1	805115-7	X	X	X	X	X	X	
MWSB04aT1	805115-8	X						
MWSB03aR1	805115-9	X	X	X	X	X	X	
MWSB001R1	805115-10	X	X	X	X	X	X	
MWSB002R1	805115-11	X	X	X	X	X	X	
MWSB015R1	805115-12	X	X	X	X	X	X	
MWSB009R1SP	805115-13	X	X	X	X	X	X	
MWSB03aE1	805115-14	X	X	X	X	X	X	
MWSB015T1	805115-15	X						

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Volatile Organics	Sediments	189 pages	Debbie Copsey	Lorraine L. Davis
Semivolatile Organics	Water	85 pages	Thomas S. Davis	Lorraine L. Davis
Semivolatile Organics	Sediment	907 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	347 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	309 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Water	116 pages	Lorraine L. Davis	Thomas S. Davis

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Metals	Sediment	133 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	47 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	31 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	11 pages	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: There were changes and obliterations on the chain-of-custody that were missing initials and dates.

Sample No. MWSB04bR1SP was listed as "HOLD" on the Chain-of-Custody. The lab reported results for this sample and no change orders were evident in the data packages.

The Chain-of-Custody for samples subcontracted to Columbia Analytical Services shows a break in custody from the time the samples were relinquished by MultiChem Analytical Services to when the samples were accepted by Columbia Analytical Services. There is no documentation such as bill of lading or airbill to indicate a courier service was used.

Foster Wheeler has investigated this issue and the sample shipping codes are on file with MultiChem and Federal Express. No further action is required.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: The date of sample collection is missing from Sample Nos. MWSB015T1 and MWSB04aT1 (Pages 72 and 51). Although there are trip blanks, they should be associated with each day's sampling events. The laboratory had been contacted to provide the data.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB008R1SP	Tetrachloroethene	Internal Standard	2.8 UE
	Ethylbenzene		2.8 UE
	m-, p-Xylene		2.8 UE
	o-Xylene		2.8 UE
MWSB009R1	1,3-Dichlorobenzene	Internal Standard	4.2 UE
	1,4-Dichlorobenzene		4.2 UE
	1,2-Dichlorobenzene		4.2 UE
	1,2,4-Trichlorobenzene		11 UE
MWST045R1	1,3-Dichlorobenzene	Internal Standard	3.9 UE
	1,4-Dichlorobenzene		3.9 UE
	1,2-Dichlorobenzene		3.9 UE
	1,2,4-Trichlorobenzene		9.8 UE

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWST009R1SP	1,3-Dichlorobenzene	Internal Standard	4.5 UE
	1,4-Dichlorobenzene		4.5 UE
	1,2-Dichlorobenzene		4.5 UE
	1,2,4-Trichlorobenzene		11 UE
MWSB04aR1	1,3-Dichlorobenzene	Internal Standard	8.2 UE
	1,4-Dichlorobenzene		8.2 UE
	1,2-Dichlorobenzene		8.2 UE
	1,2,4-Trichlorobenzene		20 UE

Discussion: Internal standards Chlorobenzene-d5 and 1,4-Dichlorobenzene-d4 were out of criteria for Sample Nos. MWSB008R1SP, MWSB009R1, MWST045R1, MWSB009R1SP, and MWSB04aR1. The associated compounds have been flagged with "E" or "UE" for estimated. Samples No. MWSB008R1SPRE, MWSB009R1RE, MWST045R1RE, MWSB009R1SPRE, and MWSB04aR1RE are also affected by internal standards that are out of criteria, but are flagged "R" elsewhere in this report.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB008R1SPRE	All Volatile Organics	Excessive Dilution	R
MWSB009R1RE	All Volatile Organics	Excessive Dilution	R
MWST045R1RE	All Volatile Organics	Excessive Dilution	R
MWST009R1SPRE	All Volatile Organics	Excessive Dilution	R
MWSB04aR1RE	All Volatile Organics	Excessive Dilution	R

Discussion: Five samples were diluted due to suspected high levels of target compounds. In these instances, the laboratory reported one result for the original analysis and one for each dilution, for a total of two sets of results for each sample. To condense

the results into one set of usable results per sample, the results that were above the calibration range or which should not be used due to excessive dilution, have been flagged "R" for unusable.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process so that the QBD project manager could request the missing sample dates for MWSB005T1 and MWSB04AT1 (pages 72 and 51). This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data for samples that are flagged with an "R" are not acceptable for use. The analyses were not within the requirements of the referenced method and significant discrepancies were observed between raw data and reported data results. Those compounds that were flagged "R" were re-analyses of the samples. All samples still have reported values for each analyte.

For the other samples, the data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Within the initial fourteen day holding time, the laboratory had extracted Sample No. MWSB04bR1SP, but the surrogate recoveries were out of criteria. At the time of extraction, the laboratory had also frozen a portion of the sample. This frozen aliquot was thawed and re-analyzed after fourteen days had elapsed. Because PSEP recommendations list a one year holding time for frozen sediments for this analysis, the holding time was not exceeded.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB03aE1	Benzidine	Continuing Calibration	94 UE
MWSB04bR1	di-n-Octylphthalate Benzo(g,h,i)perlyene	Continuing Calibration	81 UE 220 E

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB009R1	di-n-Octylphthalate Benzo(g,h,i)perlyene	Continuing Calibration	83 UE 520 E
MWSB045R1	di-n-Octylphthalate Benzo(g,h,i)perlyene	Continuing Calibration	100 UE 240 E
MWSB03aR1	di-n-Octylphthalate Benzo(g,h,i)perlyene	Continuing Calibration	100 UE 250 E
MWSB001R1	di-n-Octylphthalate Benzo(g,h,i)perlyene	Continuing Calibration	87 UE 70 E
MWSB002R1	di-n-Octylphthalate Benzo(g,h,i)perlyene	Continuing Calibration	83 UE 64 E

Discussion: A continuing calibration check for Benzidine that was associated with Sample No. MWSB03aE1 had a percent difference greater than 50%. Although there are no method or QAPP requirements for this compound, the professional judgment of the reviewer is that this result should be flagged "UE" for estimated reporting limit.

The continuing calibration checks for di-n-Octylphthalate and Benzo(g,h,i)perylene on July 11, 1998 had percent differences greater than 50%. Although there are no method or QAPP requirements for this compound, the professional judgment of the reviewer is that samples associated with this result should be flagged "E" or "UE" for estimated.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Bis(2-Ethylhexyl)phthalate, Phenol, and Benzoic Acid were detected in the method blanks analyzed with this SDG. The concentration of each compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: Several samples and quality control check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data flags are recommended unless at least two surrogates are out of criteria.

The original analysis of Sample No. MWSB04bR1SP was out of criteria for two surrogates. The laboratory appropriately re-extracted a frozen aliquot within the holding time for frozen sediment samples. This re-analysis was within criteria and the laboratory properly reported only the results of the re-analysis.

Three samples had a single surrogate out of criteria in the concentrated re-analysis for n-Nitrosodiphenylamine, but the initial sample analysis surrogate results were acceptable. No data qualifier flags are recommended.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB04aR1	Benzyl Alcohol	MS/MSD and BS/BSD	2.3 E
	2,4-Dimethylphenol		1.3 E
MWSB04bR1SP	Benzyl Alcohol	MS/MSD and BS/BSD	85 E
	2,4-Dimethylphenol		6.1 E
MWSB04bR1SP	Dimethylphthalate	BS/BSD	45 UE
	Diethylphthalate		29 E
	n-Nitrosodiphenylamine		15 UE
	Butylbenzylphthalate		30 E
	Bis(2-Ethylhexyl)phthalate		97 E

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB03bR1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	2.2 E 80 E
MWSB04bR1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	7.3 E 13 E
MWSB008R1SP	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	3.6 E 3.0 E
MWSB009R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	6.6 E 23 E
MWST045R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	5.0 E 6.0 E
MWSB03aR1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	3.8 E 28 E
MWSB001R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	3.3 E 43 UE
MWSB002R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	2.3 E 1.2 E
MWSB015R1	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	50 UE 2.8 E
MWSB009R1SP	Benzyl Alcohol 2,4-Dimethylphenol	MS/MSD and BS/BSD	5.7 E 9.9 E

Discussion: Benzyl Alcohol and 2,4-Dimethylphenol were out of criteria for both accuracy and precision in both the MS/MSD and BS/BSD pair. All associated samples have been flagged as "E" or "UE" for estimated.

For several other analytes, a single blank spike or matrix spike was out of criteria but all other accuracy measurements (e.g., other matrix spikes, other blank spikes, surrogates and calibration verifications) are acceptable, and/or the percent recovery was within QAPP criteria. No data qualifier flags are recommended.

The laboratory re-extracted three samples, one of which was from this SDG, on June 17, 1998 with a BS/BSD, but failed to extract a MS/MSD pair with the batch. No data qualifier flags are recommended for the acid fractions because the BS/BSD and all other quality control checks were acceptable. For the base/neutral fraction, Dimethylphthalate, Diethylphthalate, n-Nitrosodiphenylamine, Butylbenzylphthalate, and bis(2-Ethylhexyl)phthalate were out of criteria on the BS/BSD. Sample No. MWSB04bR1SP is flagged "E" and "UE" for estimated for these analytes.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: The laboratory noted in their case narrative that the internal standards were out of criteria for both the acid and base/neutral fractions of several samples. The reviewer concurs that the corrective action (e.g., re-analysis or using results from a different dilution) was appropriate, and no data qualifier flags are recommended.

Internal standards were out of criteria for several samples for the concentrated re-analysis for n-Nitrosodiphenylamine, but none were the internal standard associated with the target analyte, and no data qualifier flags are recommended.

The case narrative noted that internal standards were out of criteria for Sample No. MWSB015R1, but a review of the raw data indicated that the internal standards were acceptable. The laboratory was contacted and requested to re-issue a revised case narrative.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(k)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB04bR1SP	Benzoic Acid	Linear Range Exceeded	990 E

Discussion: Sample No. MWSB04bR1SP contained Benzoic Acid which was quantitated at a level greater than the highest standard, and has been flagged "E" for estimated.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request clarification on RPD calculations and to request a revised case narrative regarding internal standards for Sample No. MWSB015R1. This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several continuing calibration checks were out of criteria for various dates and columns. However, no data qualifier flags are recommended because either the continuing calibration check was high and the associated sample results were non-detect, or all quantitation was performed from the second column which had acceptable results.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recoveries for one surrogate on one column for several samples and QC check samples were out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Except as noted below, quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

The reporting limits meet requirements of the contract.

Discussion: The laboratory noted that the positive hits for 4,4'-DDD and 4,4'-DDT for Samples No. MWSB03bR1, MWSB008R1, MWSB009R1, MWSB03aR1, and the matrix spike duplicate exceeded the CLP criteria of 25% difference for quantitation on two columns and has already flagged the results. These results are either within the 40% difference criterion recommended by EPA Method 8000B

and/or the laboratory has reported the higher of the two results appropriately. No additional qualifier flags are recommended

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate on the Blank Spike and on Sample No. MWSB009R1 was out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: A single blank spike associated with Sample No. MWSB03aE1 was out of criteria but all other accuracy measurements (e.g., matrix spikes, surrogates and calibration verifications) are acceptable and no data qualifying flags are recommended.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts. The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting levels.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and was within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: The raw data for Sample No. MWSB04bR1 is missing Total Solids. The laboratory has been contacted to issue the data directly to Foster Wheeler Environmental to complete the data package.

2. Initial and Continuing Calibration

All initial calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB04aR1	Total Organic Carbon	Duplicate	12200 E
MWSB03bR1	Total Organic Carbon	Duplicate	31200 E
MWSB04bR1SP	Total Organic Carbon	Duplicate	26900 E
MWSB04bR1	Total Organic Carbon	Duplicate	35000 E
MWSB008R1SP	Total Organic Carbon	Duplicate	31600 E
MWSB009R1	Total Organic Carbon	Duplicate	32900 E
MWST045R1	Total Organic Carbon	Duplicate	52700 E
MWSB03aR1	Total Organic Carbon	Duplicate	28500 E
MWSB001R1	Total Organic Carbon	Duplicate	20000 E
MWSB002R1	Total Organic Carbon	Duplicate	9980 E
MWSB015R1	Total Organic Carbon	Duplicate	14900 E
MWSB009R1SP	Total Organic Carbon	Duplicate	36000 E

Discussion: Total Organic Carbon was out of criteria for precision for the MS/MSD pair. Samples No. MWSB04aR1, MWSB03bR1, MWSB04bR1SP, MWSB04bR1, MWSB008R1SP, MWSB009R1, MWST045R1, MWSB03aR1, MWSB001R1, MWSB002R1, MWSB015R1 and MWSB009R1SP have been flagged as "E" for estimated.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Associated Samples	Analyte	Type of Deviation	Flag
MWST045R1	Grain size	Calculation Error	52.1
MWSB001R1	Grain size	Calculation Error	11.8
MWSB03aR1	Grain size	Calculation Error	10.7
MWSB03bR1	Grain size	Calculation Error	18.8
MWSB04aR1	Grain size	Calculation Error	12.3
MWSB009R1	Grain size	Calculation Error	43.0
MWSB009R1SP	Grain size	Calculation Error	64.1
MWSB015R1	Grain size	Calculation Error	15.7

Discussion: Calculation errors were found in determining the final results. Corrected values are listed in the summary table and on the laboratory final report forms.

8. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process so that the QBD project manager could request that the raw data for Total Solids be provided to Foster Wheeler. This was followed up by fax notes, copies of which are appended to this validation report.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Quality By Design

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
360	MWSB04aR1	805115-1	8260	49	1,3-Dichlorobenzene	8.2	UE	Internal Standard
360	MWSB04aR1	805115-1	8260	50	1,4-Dichlorobenzene	8.2	UE	Internal Standard
360	MWSB04aR1	805115-1	8260	47	1,2-Dichlorobenzene	8.2	UE	Internal Standard
360	MWSB04aR1	805115-1	8260	38	1,2,4-Trichlorobenzene	20	UE	Internal Standard
265	MWSB009R1SP RE	805115-13 RE	8260	40	Tetrachloroethene	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	39	Ethylbenzene	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	53	(m+p)-Xylenes	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	41	o-Xylene	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	49	1,3-Dichlorobenzene	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	50	1,4-Dichlorobenzene	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	47	1,2-Dichlorobenzene	9.1	UR	Excessive Dilution
265	MWSB009R1SP RE	805115-13 RE	8260	38	1,2,4-Trichlorobenzene	23	UR	Excessive Dilution
261	MWSB008R1SP	805115-5	8260	40	Tetracholoroethene	2.8	UE	Internal Standard
261	MWSB008R1SP	805115-5	8260	39	Ethylbenzene	2.8	UE	Internal Standard
261	MWSB008R1SP	805115-5	8260	53	m,p-Xylene	2.8	UE	Internal Standard
261	MWSB008R1SP	805115-5	8260	41	o-Xylene	2.8	UE	Internal Standard
261	MWSB008R1SP RE	805115-5 RE	8260	40	Tetrachloroethene	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	39	Ethylbenzene	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	53	(m+p)-Xylenes	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	41	o-Xylene	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	49	1,3-Dichlorobenzene	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	50	1,4-Dichlorobenzene	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	47	1,2-Dichlorobenzene	6.9	UR	Excessive Dilution
261	MWSB008R1SP RE	805115-5 RE	8260	38	1,2,4-Trichlorobenzene	17	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	40	Tetrachloroethene	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	39	Ethylbenzene	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	53	(m+p)-Xylenes	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	41	o-Xylene	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	49	1,3-Dichlorobenzene	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	50	1,4-Dichlorobenzene	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	47	1,2-Dichlorobenzene	8.5	UR	Excessive Dilution
263	MWSB009R1 RE	805115-6RE	8260	38	1,2,4-Trichlorobenzene	21	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	40	Tetrachloroethene	9.8	UR	Excessive Dilution

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
348	MWST045R1 RE	805115-7 RE	8260	39	Ethylbenzene	9.8	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	53	(m+p)-Xylenes	9.8	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	41	o-Xylene	9.8	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	49	1,3-Dichlorobenzene	9.8	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	50	1,4-Dichlorobenzene	9.8	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	47	1,2-Dichlorobenzene	9.8	UR	Excessive Dilution
348	MWST045R1 RE	805115-7 RE	8260	38	1,2,4-Trichlorobenzene	24	UR	Excessive Dilution
263	MWSB009R1	805115-6	8260	49	1,3-Dichlorobenzene	4.2	UE	Internal Standard
263	MWSB009R1	805115-6	8260	50	1,4-Dichlorobenzene	4.2	UE	Internal Standard
263	MWSB009R1	805115-6	8260	47	1,2-Dichlorobenzene	4.2	UE	Internal Standard
263	MWSB009R1	805115-6	8260	38	1,2,4-Trichlorobenzene	11	UE	Internal Standard
265	MWSB009R1SP	805115-13	8260	49	1,3-Dichlorobenzene	4.5	UE	Internal Standard
265	MWSB009R1SP	805115-13	8260	50	1,4-Dichlorobenzene	4.5	UE	Internal Standard
265	MWSB009R1SP	805115-13	8260	47	1,2-Dichlorobenzene	4.5	UE	Internal Standard
265	MWSB009R1SP	805115-13	8260	38	1,2,4-Trichlorobenzene	11	UE	Internal Standard
348	MWST045R1	805115-7	8260	49	1,3-Dichlorobenzene	3.9	UE	Internal Standard
348	MWST045R1	805115-7	8260	50	1,4-Dichlorobenzene	3.9	UE	Internal Standard
348	MWST045R1	805115-7	8260	47	1,2-Dichlorobenzene	3.9	UE	Internal Standard
348	MWST045R1	805115-7	8260	38	1,2,4-Trichlorobenzene	9.8	UE	Internal Standard
416	MWSB03aE1	805115-14	8270	115	Benzidine	94	UE	Continuing Calibration
362	MWSB04bR1	805155-4	8270	11	di-n-Octylphthalate	81	UE	Continuing Calibration
362	MWSB04bR1	805155-4	8270	4	Benzo(g,h,i)perylene	220	E	Continuing Calibration
263	MWSB009R1	805115-6	8270	11	di-n-Octylphthalate	83	UE	Continuing Calibration
263	MWSB009R1	805115-6	8270	4	Benzo(g,h,i)perylene	520	E	Continuing Calibration
348	MWSB045R1	805115-7	8270	11	di-n-Octylphthalate	100	UE	Continuing Calibration
348	MWSB045R1	805115-7	8270	4	Benzo(g,h,i)perylene	240	E	Continuing Calibration
333	MWSB03aR1	805115-9	8270	11	di-n-Octylphthalate	100	UE	Continuing Calibration
333	MWSB03aR1	805115-9	8270	4	Benzo(g,h,i)perylene	250	E	Continuing Calibration
257	MWSB001R1	805115-10	8270	11	di-n-Octylphthalate	87	UE	Continuing Calibration
257	MWSB001R1	805115-10	8270	4	Benzo(g,h,I)perylene	70	E	Continuing Calibration
258	MWSB002R1	805115-11	8270	11	di-n-Octylphthalate	83	UE	Continuing Calibration
258	MWSB002R1	805115-11	8270	4	Benzo(g,h,i)perylene	64	E	Continuing Calibration
360	MWSB04aR1	805115-1	8270	7	Benzyl Alcohol	2.3	E	MS/MSD & BS/BSD

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
360	MWSB04aR1	805115-1	8270	68	2,4-Dimethylphenol	1.3	E	MS/MSD & BS/BSD
399	MWSB04bR1SP	805115-2RE	8270	7	Benzyl Alcohol	85	E	MS/MSD & BS/BSD
399	MWSB04bR1SP	805115-2RE	8270	68	2,4-Dimethylphenol	6.1	E	MS/MSD & BS/BSD
399	MWSB04bR1SP	805115-2RE	8270	6	Benzoic Acid	990	E	Linear Range Exceeded
399	MWSB04bR1SP	805115-2	8270	15	Dimethylphthalate	45	UE	BS/BSD
399	MWSB04bR1SP	805115-2	8270	14	Diethylphthalate	29	E	BS/BSD
399	MWSB04bR1SP	805115-2	8270	19	n-Nitrosodiphenylamine	15	UE	BS/BSD
399	MWSB04bR1SP	805115-2	8270	8	Butylbenzylphthalate	30	E	BS/BSD
399	MWSB04bR1SP	805115-2	8270	28	bis(2-Ethylhexyl)phthalate	97	E	BS/BSD
334	MWSB03bR1	805115-3	8270	7	Benzyl Alcohol	2.2	E	MS/MSD & BS/BSD
334	MWSB03bR1	805115-3	8270	68	2,4-Dimethylphenol	80	E	MS/MSD & BS/BSD
362	MWSB04bR1	805115-4	8270	7	Benzyl Alcohol	7.3	E	MS/MSD & BS/BSD
362	MWSB04bR1	805115-4	8270	68	2,4-Dimethylphenol	13	E	MS/MSD & BS/BSD
261	MWSB008R1SP	805115-5	8270	7	Benzyl Alcohol	3.6	E	MS/MSD & BS/BSD
261	MWSB008R1SP	805115-5	8270	68	2,4-Dimethylphenol	3.0	E	MS/MSD & BS/BSD
263	MWSB009R1	805115-6	8270	7	Benzyl Alcohol	6.6	E	MS/MSD & BS/BSD
263	MWSB009R1	805115-6	8270	68	2,4-Dimethylphenol	23	E	MS/MSD & BS/BSD
348	MWST045R1	805115-7	8270	7	Benzyl Alcohol	5.0	E	MS/MSD & BS/BSD
348	MWST045R1	805115-7	8270	68	2,4-Dimethylphenol	6.0	E	MS/MSD & BS/BSD
333	MWSB03aR1	805115-9	8270	7	Benzyl Alcohol	3.8	E	MS/MSD & BS/BSD
333	MWSB03aR1	805115-9	8270	68	2,4-Dimethylphenol	28	E	MS/MSD & BS/BSD
257	MWSB001R1	805115-10	8270	7	Benzyl Alcohol	3.3	E	MS/MSD & BS/BSD
257	MWSB001R1	805115-10	8270	68	2,4-Dimethylphenol	43	UE	MS/MSD & BS/BSD
258	MWSB002R1	805115-11	8270	7	Benzyl Alcohol	2.3	E	MS/MSD & BS/BSD
258	MWSB002R1	805115-11	8270	68	2,4-Dimethylphenol	1.2	E	MS/MSD & BS/BSD
271	MWSB015R1	805115-12DL	8270	7	Benzyl Alcohol	50	UE	MS/MSD & BS/BSD
271	MWSB015R1	805115-12DL	8270	68	2,4-Dimethylphenol	2.8	E	MS/MSD & BS/BSD
265	MWSB009R1SP	805115-13	8270	7	Benzyl Alcohol	5.7	E	MS/MSD & BS/BSD
265	MWSB009R1SP	805115-13	8270	68	2,4-Dimethylphenol	9.9	E	MS/MSD & BS/BSD
360	MWSB04aR1	805115-1	SM5310B	29	Total Organic Carbon	12200	E	Duplicate
399	MWSB04bR1SP	805115-2	SM5310B	29	Total Organic Carbon	26900	E	Duplicate
334	MWSB03bR1	805115-3	SM5310B	29	Total Organic Carbon	31200	E	Duplicate
362	MWSB04bR1	805115-4	SM5310B	29	Total Organic Carbon	35000	E	Duplicate

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
261	MWST008R1SP	805115-5	SM5310B	29	Total Organic Carbon	31600	E	Duplicate
263	MWSB009R1	805115-6	SM5310B	29	Total Organic Carbon	32900	E	Duplicate
348	MWST045R1	805115-7	SM5310B	29	Total Organic Carbon	52700	E	Duplicate
333	MWSB03AR1	805115-9	SM5310B	29	Total Organic Carbon	28500	E	Duplicate
257	MWSB001R1	805115-10	SM5310B	29	Total Organic Carbon	20000	E	Duplicate
258	MWSB002R1	805115-11	SM5310B	29	Total Organic Carbon	9980	E	Duplicate
271	MWSB015R1	805115-12	SM5310B	29	Total Organic Carbon	14900	E	Duplicate
265	MWSB009R1SP	805115-13	SM5310B	29	Total Organic Carbon	36000	E	Duplicate
360	MWSB04aR1	805115-1	ASTM422M	79	Percent Fines	12.3		Calculation Error
334	MWSB03bR1	805115-3	ASTM422M	79	Percent Fines	18.8		Calculation Error
263	MWSB009R1	805115-6	ASTM422M	79	Percent Fines	43		Calculation Error
348	MWST045R1	805115-7	ASTM422M	79	Percent Fines	52.1		Calculation Error
333	MWSB03AR1	805115-9	ASTM422M	79	Percent Fines	10.7		Calculation Error
257	MWSB001R1	805115-10	ASTM422M	79	Percent Fines	11.8		Calculation Error
271	MWSB015R1	805115-12	ASTM422M	79	Percent Fines	15.7		Calculation Error
265	MWSB009R1SP	805115-13	ASTM422M	79	Percent Fines	64.1		Calculation Error

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

SDG No.: 805115

Method: PSEP

No. of Samples: 15

Reviewer: Quality by Design

Laboratory: MultiChem Analytical Service

Data Use: Foster Wheeler Environmental Corp.

Review Completion Data: October 14, 1998

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	M	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	N/A
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	M	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	M	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	M	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	M	M	O	O	M	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol and 2,4-Dimethylphenol, continuing calibration checks for di-n-Octylphthalate and Benzo(g,h,i)perlyene, and duplicate analysis for TOC. Several values for grain size were revised due to calculation errors.

DATA EVALUATION SUMMARY

SDG No. 805115

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 15

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA						20		20	20/120 = 16.7%
SVOA			13		29			42	42/84 = 50.0%
PEST								0	0/60 = 0%
PCB								0	0/84 = 0%
METALS								0	0/276 = 0%
INORG					12		8**	20	20/84 = 23.8%

Note Asterisk (*) indicates additional exceedances of review criteria ** Indicates calculation errors

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA							32	32	32/120 = 26.7%
SVOA								0	0/84 = 0%
PEST								0	0/60 = 0%
PCB								0	0/84 = 0%
METALS								0	0/276 = 0%
INORG								0	0/84 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

C:\My Documents\winword\QBD\DATAVAL\Foster-Wheeler\Data Rejection Summary\805115 drs doc

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 26 & 27, 1998
SDG No. 805116

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction 2
B. Chain-of-Custody and Sample Receipt 4
C. Review of Organic Tin Analyses 5

Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
Attachment 3 Data Flag Summary
Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of one data package from Columbia Analytical Servies in Kelso, Washington and contains data for the samples listed in Table 1.

Each data set includes an analytical data package for each sample, copies of the completed chain-of-custody forms, and a Quality Control (QC) Data Package. The analytical data package includes analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates but not times, detection limits, method references, surrogate recoveries as appropriate, the laboratory's name and address and the analyst's initials. The custody forms include the receipt of the sample but not the laboratory's internal tracking. The QC Data Package includes a tabular listing of the laboratory's sample identification, spiking concentrations, recoveries, percentage calculations, and acceptance windows. Supporting documentation includes chromatograms and instrumental printouts for the samples, QC checks and calibration.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SV	PEST	PCB	MET	INORG	TBT
MWSS025R1S	805116-1							X
MWSS025R1	805116-2							X
MWSS024R1S	805116-3							X
MWSS024R1 (MS/MSD)	805116-4							X
MWSS054R1	805116-5							X
MWSS040R1	805116-6							X
MWSS040R1S	805116-7							X
MWSS022R1	805116-8							X

Key:

VOA	=	Volatile Organic Compounds
SV	=	Semi-volatile Organic Compounds
PEST	=	Chlorinated Pesticides
PCB	=	Polychlorinated Biphenyls
MET	=	Trace Metals
INORG	=	Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT	=	Tributyl Tin

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The Chain-of-Custody contains a gap in custody of about 24 hours, presumably for shipping from MAS to CAS. The waybills are not attached and neither lab noted that the samples were relinquished or received from a freight carrier.

Foster Wheeler has investigated this issue and while Chain-of-Custody documentation was not complete, the reviewer was provided with a written statement that the samples were maintained in proper custody and the coolers sealed during the time in question. In addition, sample shipping codes are on file with Multichem and Federal Express for the transport to CAS. The Chain-of-Custody was maintained for the samples and no further action is required.

C. Review of Organic Tin Analyses

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Pages 112-115 of the data package are financial statements from the laboratory that apparently were mixed into the package by mistake. These pages should be removed from the package before any further distribution of the data.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	TCL Compound Affected	Type of Deviation	Flag
MWSS024R1	Butyltin	MS/MSD	0.05 UE

Discussion: Butyltin was out of criteria for both accuracy (percent recovery) and precision (RPD) for the MS/MSD pair. Only the result for this compound in the spiked sample have been flagged with a "UE" for detection limit because all other QC checks (such as the surrogate and LCS) were acceptable.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

Discussion: The chromatograms and worksheets used for processing the data include a calculation which converts butyl tin to the equivalent units as tin only. However, the laboratory reported the results of these samples in units of µg/L as mono-, di-, tri-, and tetra-Butyltin, as appropriate for each analyte.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

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E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
286	MWSS024R1	805116-4	Krone	84	Butyltin	0.05	UE	MS/MSD

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805116

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 8

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	N/A	N/A	N/A	N/A	N/A	N/A	O
GC/MS Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Initial & Continuing Calibration	N/A	N/A	N/A	N/A	N/A	N/A	O
Field Blanks (F=N/A)	N/A	N/A	N/A	N/A	N/A	N/A	F
Laboratory Blanks	N/A	N/A	N/A	N/A	N/A	N/A	O
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A	O
Matrix Spikes/Duplicates	N/A	N/A	N/A	N/A	N/A	N/A	X
QC Samples (LCS, PVS)	N/A	N/A	N/A	N/A	N/A	N/A	O
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Identification	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Quantification	N/A	N/A	N/A	N/A	N/A	N/A	O
System Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Overall Assessment	N/A	N/A	N/A	N/A	N/A	N/A	X

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: A single value for organic tin was qualified due to a MS/MSD failure.

DATA EVALUATION SUMMARY

SDG No. 805116

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 8

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
TBT					1			1	1/32 = 3.1%

Note Asterisk (*) indicates additional exceedances of review criteria

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MD/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
TBT								0	0/32= 0%

Note Asterisk (*) indicates additional exceedances of review criteria.

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 28, 1998
SDG No. 806012

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
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Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., dba *Quality by Design*, has completed an EPA Level II Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of several data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data packages size, data reviewer and senior reviewer are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	PEST	PCB	MET	INORG	TBT
MWSB015S1	806012-1	X	X	X	X	X	X	

Key:

VOA = Volatile Organic Compounds
SV = Semi-volatile Organic Compounds
PEST = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
MET = Trace Metals
INORG = Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT = Tributyl Tin

Table 2: Data Reviewer and Senior Reviewer

Analysis	Matrix	Data Package	Reviewer	Senior Reviewer
Semivolatile Organics	Sediment	236 pages	Thomas S. Davis	Lorraine L. Davis
Pesticides	Sediment	223 pages	Thomas S. Davis	Lorraine L. Davis
PCBs	Sediment	189 pages	Thomas S. Davis	Lorraine L. Davis
Metals	Sediment	136 pages	Lorraine L. Davis	Thomas S. Davis
Inorganics	Sediment	38 pages	Lorraine L. Davis	Thomas S. Davis
TOC	Sediment	16 pages	Lorraine L. Davis	Thomas S. Davis
Sample Receiving	Water and Sediment	1 page	Lorraine L. Davis	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: There is a break in Chain-of-Custody between the time MultiChem Analytical Service relinquished the samples and the time that Columbia Analytical Service received the samples. There was no bill of lading or airbill to indicate a courier had been used. Foster Wheeler has investigated this issue and the sample shipping codes are on file with MultiChem Analytical Service and Federal Express. No further action is required.

The samples were received at Columbia Analytical Services at 9.7°C, which is outside the acceptance criteria of 4 ± 2°C. No data flags are recommended since the slightly elevated temperature would not have impacted the sample analysis.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration quality control criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation of the quality control checks was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were detected in the laboratory blanks.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Bis(2-Ethylhexyl)phthalate, Diethylphthalate, Phenol, and Benzoic Acid were detected in the method blanks analyzed with this SDG. The concentration of each compound was less than the reporting limit. The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The Blank Spike and Blank Spike Duplicate check samples had one surrogate out of criteria in either the acid or the base/neutral fraction but per Functional Guidelines and the referenced method, no data qualifier flags would be recommended unless both surrogates are out of criteria.

A single surrogate out of criteria in the concentrated re-analysis for n-Nitrosodiphenylamine for Sample No. MWSB015S1 but the initial sample analysis surrogate results were acceptable. No data qualifier flags are recommended.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
MWSB015S1	Benzyl Alcohol Benzo(a)pyrene	BS/BSD	19 UE 230E

Discussion: The laboratory failed to extract a MS/MSD pair with the batch associated with Sample No. MWSB015S1. Three analytes were out of criteria for the BSD but no data qualifier flags are recommended the Blank Spike and all other quality control checks were acceptable. Benzyl Alcohol and Benzo(a)pyrene were out of criteria for both the BS and the BSD, and this sample is flagged "E" for estimated for these analytes.

7. Field Duplicates

No field duplicates were identified with this group of samples.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

Except as noted below, all TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

Discussion: The laboratory noted that Benzo(b)fluoranthene and Benzo(h)fluoranthene could not be adequately resolved. The results are a summation of the two analytes.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process to request clarification on RPD calculations and to request a revised case narrative regarding internal standards for Sample No. MWSB015S1. This was followed up by fax notes, copies of which are appended to this validation report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: Several analytes were out of criteria on a continuing calibration check associated with this sample, however, no data qualifier flags are recommended because the continuing calibration check was high and the associated sample was non-detect.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

No TCL Compounds were detected.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts. The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The percent recovery for one surrogate on the Blank Spike and the Blank Spike Duplicate was out of criteria, but per Functional Guidelines and the referenced method, no data flags are required unless both surrogates are out of criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

No TCL Compounds were detected.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts. The reporting limits meet requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metals Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. ICP Interference Check Standard

The Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: Matrix spike duplicate RPD was out of criteria. The laboratory has already flagged the data appropriately with "*" to indicate the RPD was out of criteria. Since all other quality control checks are in criteria, no data qualifier flags are recommended.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for Graphite Furnace Atomic Absorption analysis were performed at a frequency required by the referenced method and were within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified with this group of samples.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

H. Review of Inorganic Analyses

Ammonia, Sulfide, TOC, and Grain Size

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within laboratory or method criteria.

5. Precision and Accuracy

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The concentration of Total Organic Carbon in the sample was greater than the spiking concentration for the matrix spike. No data qualifier flags are recommended because the percent recovery was within criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Except as notes below, no errors in accuracy were found.

Discussion: The date of analysis for Ammonia for Sample No. MWSB015S1 is incorrect on the laboratory report. The date of analysis should be June 10, 1998. The laboratory has been contracted to issue a revision directly to Foster Wheeler.

8. Laboratory Contact

The QBD project manager telephoned Kim Lofgren at MultiChem Analytical Services during the data validation process so that the QBD project manager could request that the date of analysis of ammonia be corrected and the revision sent direct to Foster Wheeler.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
398	MWSB015S1	806012-1	8270	7	Benzyl Alcohol	19	UE	BS/BSD
398	MWSB015S1	806012-1	8270	2	Benzo(a)pyrene	230	E	BS/BSD

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

SDG No.: 806012

Method: PSEP

No. of Samples: 1

Reviewer: Quality by Design

Laboratory: MultiChem Analytical Service

Data Use: Foster Wheeler Environmental Corp.

Review Completion Data: October 14, 1998

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	O	O	O	O	O	O	N/A
GC/MS Performance	O	O	O	O	O	O	N/A
Initial & Continuing Calibration	O	O	O	O	O	O	N/A
Field Blanks (F=N/A)	O	F	F	F	F	F	N/A
Laboratory Blanks	O	O	O	O	O	O	N/A
Surrogates	O	O	O	O	O	O	N/A
Matrix Spikes/Duplicates	O	M	O	O	O	O	N/A
QC Samples (LCS, PVS)	O	O	O	O	O	O	N/A
Internal Standards	O	O	O	O	O	O	N/A
Compound Identification	O	O	O	O	O	O	N/A
Compound Quantification	O	O	O	O	O	O	N/A
System Performance	O	O	O	O	O	O	N/A
Overall Assessment	O	M	O	O	O	O	N/A

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Data qualifiers involved MS/MSD and BS/BSD failures for Benzyl Alcohol and Benzo(a)pyrene.

DATA EVALUATION SUMMARY

SDG No. 806012

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 1

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
VOA								0	0/8 = 0%
SVOA					2			2	2/7 = 28.6%
PEST								0	0/5 = 0%
PCB								0	0/7 = 0%
METALS								0	0/23 = 0%
INORG								0	0/7 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/8 = 0%
SVOA								0	0/7 = 0%
PEST								0	0/5 = 0%
PCB								0	0/7 = 0%
METALS								0	0/23 = 0%
INORG								0	0/7 = 0%

Note Asterisk (*) indicates additional exceedances of review criteria

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 15, 1998
SDG No. 805086

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction 2
B. Chain-of-Custody and Sample Receipt 4
C. Review of Organic Tin 5

Attachment 1 Data Evaluation Summary
Attachment 2 Communications with the Laboratory

A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of one data package from Columbia Analytical Services in Kelso, Washington and contains data for the samples listed in Table 1.

Each data set includes an analytical data package for each sample, copies of the completed chain-of-custody forms, and a Quality Control (QC) Data Package. The analytical data package includes analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates but not times, detection limits, method references, surrogate recoveries as appropriate, the laboratory's name and address and the analyst's initials. The custody forms include the receipt of the sample but not the laboratory's internal tracking. The QC Data Package includes a tabular listing of the laboratory's sample identification, spiking concentrations, recoveries, percentage calculations, and acceptance windows. Supporting documentation includes chromatograms and instrumental printouts for the samples, QC checks and calibration.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SV	PEST	PCB	MET	INORG	TBT
MWST034R1	805086-1							X
MWST035R1	805086-2							X
MWST028R1	805086-3							X
MWST030R1	805086-4							X
MWST031R1	805086-5							X
MWST032R1	805086-6							X

Key:

VOA	=	Volatile Organic Compounds
SV	=	Semi-volatile Organic Compounds
PEST	=	Chlorinated Pesticides
PCB	=	Polychlorinated Biphenyls
MET	=	Trace Metals
INORG	=	Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT	=	Tributyl Tin

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The samples associated with this Sample Delivery Group (SDG) were collected with SDG No. 805052, then given a separate SDG number and tracked separately. Both Chain-of-Custody forms were provided as supporting documentation.

C. Review of Organic Tin

1. Timeliness and a Check for Errors

Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: One of the samples had been held for six days of the seven day holding time for extraction before delivery to the laboratory. The laboratory deserves a kudo for extracting this set of samples on the same day that the samples were delivered.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RSD) greater than that allowed by the method.

Discussion: The third continuing calibration check for Dibutyltin and the second and third continuing calibration check for Tributyltin had percent differences greater than 15%. No data qualifier flags are recommended because the 15% difference is considered to be a guideline (i.e., not a method requirement) and all other Quality Control checks are in criteria.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec.) and relative percent differences (RPD) were within laboratory or method criteria.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Report Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

Discussion: Samples No. MWSS035R1 and MWSS028R1 have elevated reporting limits due to insufficient sample.

The chromatograms and worksheets used for processing the data include a calculation which converts butyl tin to the equivalent units as tin only. However,

the laboratory reported the results of these samples in units of µg/L as mono-, di-, tri-, and tetra-Butyltin, as appropriate for each analyte.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Data Evaluation

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 805086

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 6

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	N/A	N/A	N/A	N/A	N/A	N/A	O
GC/MS Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Initial & Continuing Calibration	N/A	N/A	N/A	N/A	N/A	N/A	O
Field Blanks (F=N/A)	N/A	N/A	N/A	N/A	N/A	N/A	F
Laboratory Blanks	N/A	N/A	N/A	N/A	N/A	N/A	O
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A	O
Matrix Spikes/Duplicates	N/A	N/A	N/A	N/A	N/A	N/A	O
QC Samples (LCS, PVS)	N/A	N/A	N/A	N/A	N/A	N/A	O
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Identification	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Quantification	N/A	N/A	N/A	N/A	N/A	N/A	O
System Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Overall Assessment	N/A	N/A	N/A	N/A	N/A	N/A	O

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: None

DATA EVALUATION SUMMARY

SDG No. 805086

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 6

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
TBT								0	0/24 = 0%

Note: Asterick (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
TBT								0	0/24 = 0%

Note. Asterick (*) indicates additional exceedances of review criteria

Attachment 2
Communications with the Laboratory

FOSTER WHEELER RESPONSE TO QA REVIEW ON MIDDLE WATERWAY DATA PACKAGES

Multiple SDGs

It is noted for several SDGs that shipping Waybills were not included in the final data reports. Fed-X is now using only a scanable bar code sticker for shipping which eliminates shipping/Waybills. Samples were shipped overnight via Fed-X from MultiChem Analytical Services (MAS) to Columbia Analytical Services (CAS) and by Fed-X or Courier to Rosa Environmental and Geotechnical Laboratory and Frontier Geosciences. (Conversations with Kim Lofgren (MAS) and Richard Craven (CAS) 10/8/98).

SDG 805036

Issue:

The samples were taken on May 8, 1998 and apparently subsampled on May 11, 1998. The subsamples were received by the laboratory at a temperature of 10.0°C on May 11. A Corrective Action form was generated stating that the temperature of the samples was out of acceptance criteria of 4± 2°C, but there was no indication that the client was notified of the incident nor is there a supervisory signature approval of the Corrective Action.

Response:

The sediment cores were sampled on May 8, 1998 and delivered to Multichem where they were stored until Mark Otten of Foster Wheeler subsampled them on May 11, 1998. Foster Wheeler was notified of the temperature anomaly and Foster Wheeler chose to have samples analyzed. Kim Lofgren the project manager at Multichem forgot to sign the Corrective Action form but this was corrected on subsequent forms. (Conversation with Kim Lofgren 10/1/1998) ✓

SDG 805047

C-O-C and Sample Receipt Discussion

Issue :

The first paragraph states that samples were collected from May 11 to May 13, 1998 and received at the laboratory at a temperature of 13.3 C° on May 13 at1430.

Response:

All samples in this delivery group were submitted to the laboratory on the day they were sampled, as is indicated on what the reviewer refers to in the next paragraph of his text as a second set of C-O-Cs marked "Hold". These C-O-Cs are the originals filled out in the field and submitted with the core samples. On May 13 the samples (cores) in this group were removed from the cooler at Multichem Analytical by Mark Otten of Foster Wheeler, extruded from the core tubes, logged, and subsampled. The subsamples were then resubmitted to Multichem for selected analyses. It is this set of subsamples which were received at a temperature of 13.3 C° on May 13.

Issue:

The second paragraph of discussion indicates that original samples were relinquished by the sampler to the laboratory at 1750 on May 12, but were received by the laboratory at 1745.

Response:

This was a time difference between the wall clock in the laboratory and the samplers watch which was not noticed at the time of sample delivery. As to the date samples were relinquished, as previous stated all samples from this group were submitted to the laboratory on the day they were sampled.

SDG 805052

C-O-C and Sample Receipt Discussion

Issue:

The second paragraph of discussion indicates that two jars were received at Columbia analytical with no identification tags and that no sample was received for ammonia analysis.

Response:

MultiChem Analytical prepared a sample for ammonia analysis from surplus sample material stored in the cooler at that lab. This sample was shipped to Columbia with a copy of the original C-O-C marked up to indicate that this was a replacement sample for the one that was missing. The unlabelled bottles were disposed of at Columbia analytical.

SDG 805056

C-O-C and Sample Receipt Discussion

Issue:

The first paragraph of the discussion indicates that the samples were collected on May 12, 1998 and received at the laboratory on May 14 at a temperature of 8.7 C°.

Response:

The samples in this delivery group were submitted to the laboratory on the day they were collected. The samples were removed from the cooler at MultiChem on May 14 by Mark Otten of Foster Wheeler for subsampling. The subsamples were received back at MultiChem on May 14 at a temperature of 8.7 C°.

SDG 805086

C-O-C and Sample receipt Discussion

Issue:

The discussion indicates that chain-of-custody was not documented from sample collection to the delivery of the samples at the lab.

Response:

The samples in this delivery group were collected with SDG 805052 and the COC forms document this collection. Because these samples were designated for TBT analyses, they were given a new SDG and tracked separately. The COC for both SDGs are attached to provide this documentation.

SDG 805090

C-O-C and Sample receipt Discussion

Issue:

There were changes and obliterations on chain-of-custody with no initials and date.

Response:

Noted by Foster Wheeler

Issue:

There is a five day break in Chain-of-Custody from the time the samples were relinquished by MultiChem Analytical Services and when Columbia Analytical Services received the samples into the laboratory. There were no bills of lading or airbills to indicate a courier was used.

Response:

Multichem shipped the samples to Columbia via standard rather than priority Fed-X delivery on Friday. Consequently,the samples did not leave Seattle until Monday and arrived on Wednesday.

Issue:

Columbia Analytical did not provide any information regarding sample condition upon receipt.

Response:

Columbia did not include the cooler receipt in the data package. There were no anomalies and the temperature was 4.3° C upon receipt. Columbia is Faxing FWENC a copy of the cooler receipt. (Conversation with Richard Craven (CAS) 10/8/98).

SDG 805116

C-O-C and Sample receipt Discussion

Issue:

The Chain-of-Custody contains a gap in custody of about 24 hours, presumably for shipping from MAS to CAS. The waybills are not attached and neither lab noted that the samples were relinquished or received from a freight carrier.

Response:

These Samples were packed in a cooler and relinquished by STI on 5/28/98 at 3:00 pm with the COC inside the cooler. Steve Hoffman of STI dropped the sealed cooler of samples to MAS on 5/29/98 at 9:25 am. It is noted that the cooler was sealed with custody seals on the sample login form. STI should have relinquished the cooler to Steve Hoffman who then should have relinquished the cooler to MAS. Foster Wheeler was not notified of this error. MAS then re-packaged some samples and shipped them Fed-X to CAS.

SDG 806001

C-O-C and Sample receipt Discussion

Issue:

The Chain-of-Custody is incomplete. The samples were relinquished on May 29 by sampler but received on June 1 at MAS. The sample login checklist indicates hand delivery and no express shipment waybills are attached or referenced. The samples were then relinquished on June 1 and received by CAS on June 2, again with out referencing a waybill.

Response:

Same response as for SDG 805116.

Quality By Design

Laboratory Quality Assurance Consulting

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Phone: (808) 969-9424
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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Date of Sampling: May 28, 1998
SDG No. 806001

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Data Evaluation Summary
Attachment 2 Communication With the Laboratory

A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of one data package from Columbia Analytical Services in Kelso, Washington and contains data for the samples listed in Table 1.

Each data set includes an analytical data package for each sample, copies of the completed chain-of-custody forms, and a Quality Control (QC) Data Package. The analytical data package includes analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates but not times, detection limits, method references, surrogate recoveries as appropriate, the laboratory's name and address and the analyst's initials. The custody forms include the receipt of the sample but not the laboratory's internal tracking. The QC Data Package includes a tabular listing of the laboratory's sample identification, spiking concentrations, recoveries, percentage calculations, and acceptance windows. Supporting documentation includes chromatograms and instrumental printouts for the samples, QC checks and calibration.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SV	PEST	PCB	MET	INORG	TBT
MWST039R1	806001-1							X
MWST043R1	806001-2							X
MWST054R1S	806001-3							X
MWST048R1	806001-4							X
MWST047R1	806001-5							X
MWST043R1S	806001-6							X

Key:

VOA	=	Volatile Organic Compounds
SV	=	Semi-volatile Organic Compounds
PEST	=	Chlorinated Pesticides
PCB	=	Polychlorinated Biphenyls
MET	=	Trace Metals
INORG	=	Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT	=	Tributyl Tin

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors were found.

Discussion: The temperature blank was 0.2 °C above criteria upon receipt at Columbia Analytical Services. This nonconformance is not deemed serious enough to warrant a data qualifier flag.

The chain-of-custody is incomplete. The samples were relinquished on May 29 by the sampler but were received on June 1 at MultiChem Analytical Services. The sample log in the checklist indicates hand delivery and no express shipment waybills are attached or referenced. The samples were then relinquished on June 1 and received by Columbia Analytical Services on June 2, again without referencing a waybill.

Foster Wheeler has investigated this issue and while Chain-of-Custody documentation was not complete, the reviewer was provided with a written statement that the samples were maintained in proper custody and the coolers sealed during the time in question. In addition, sample shipping codes are on file with Multichem and Federal Express for the transport to CAS. The Chain-of-Custody was maintained for the samples and no further action is required.

C. Review of Organic Tin

1. Timeliness and a Check for Errors

No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

2. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

3. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: The Percent Recovery for one surrogate (Tripropyltin) was out of criteria in the blank associated with the data. No data flags are recommended because the surrogates in the blank and all in the samples were acceptable.

4. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: A single matrix spike for Butyltin and Tetrabutyltin were out of criteria but all other accuracy measurements (e.g., the matrix spike duplicate, surrogates and calibration verifications) are acceptable and no data qualifying flags are recommended.

5. Field Duplicates

No field duplicates were identified with this group of samples.

6. TCL Compound Identification

No TCL Compounds were detected.

7. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

Discussion: The chromatograms and worksheets used for processing the data include a calculation which converts butyl tin to the equivalent units as tin only. However, the laboratory reported the results of these samples in units of µg/L as mono-, di-, tri-, and tetra-Butyltin, as appropriate for each analyte.

8. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

9. Laboratory Contact

There was no verbal or written communication with the laboratory.

10. Other Comments

None.

11. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Data Evaluation

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 806001

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 6

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	N/A	N/A	N/A	N/A	N/A	N/A	O
GC/MS Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Initial & Continuing Calibration	N/A	N/A	N/A	N/A	N/A	N/A	O
Field Blanks (F=N/A)	N/A	N/A	N/A	N/A	N/A	N/A	F
Laboratory Blanks	N/A	N/A	N/A	N/A	N/A	N/A	O
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A	O
Matrix Spikes/Duplicates	N/A	N/A	N/A	N/A	N/A	N/A	O
QC Samples (LCS, PVS)	N/A	N/A	N/A	N/A	N/A	N/A	O
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Identification	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Quantification	N/A	N/A	N/A	N/A	N/A	N/A	O
System Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Overall Assessment	N/A	N/A	N/A	N/A	N/A	N/A	O

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: None

DATA EVALUATION SUMMARY

SDG No. 806001

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 6

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
TBT								0	0/24 0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MD/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
TBT								0	0/24 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

Attachment 2
Communications with the Laboratory

FOSTER WHEELER RESPONSE TO QA REVIEW ON MIDDLE WATERWAY DATA PACKAGES

Multiple SDGs

It is noted for several SDGs that shipping Waybills were not included in the final data reports. Fed-X is now using only a scanable bar code sticker for shipping which eliminates shipping/Waybills. Samples were shipped overnight via Fed-X from MultiChem Analytical Services (MAS) to Columbia Analytical Services (CAS) and by Fed-X or Courier to Rosa Environmental and Geotechnical Laboratory and Frontier Geosciences. (Conversations with Kim Lofgren (MAS) and Richard Craven (CAS) 10/8/98).

SDG 805036

Issue:

The samples were taken on May 8, 1998 and apparently subsampled on May 11, 1998. The subsamples were received by the laboratory at a temperature of 10.0°C on May 11. A Corrective Action form was generated stating that the temperature of the samples was out of acceptance criteria of 4± 2°C, but there was no indication that the client was notified of the incident nor is there a supervisory signature approval of the Corrective Action.

Response:

The sediment cores were sampled on May 8, 1998 and delivered to Multichem where they were stored until Mark Otten of Foster Wheeler subsampled them on May 11, 1998. Foster Wheeler was notified of the temperature anomaly and Foster Wheeler chose to have samples analyzed. Kim Lofgren the project manager at Multichem forgot to sign the Corrective Action form but this was corrected on subsequent forms. (Conversation with Kim Lofgren 10/1/1998)

SDG 805047

C-O-C and Sample Receipt Discussion

Issue :

The first paragraph states that samples were collected from May 11 to May 13, 1998 and received at the laboratory at a temperature of 13.3 C° on May 13 at1430.

Response:

All samples in this delivery group were submitted to the laboratory on the day they were sampled, as is indicated on what the reviewer refers to in the next paragraph of his text as a second set of C-O-Cs marked "Hold". These C-O-Cs are the originals filled out in the field and submitted with the core samples. On May 13 the samples (cores) in this group were removed from the cooler at Multichem Analytical by Mark Otten of Foster Wheeler, extruded from the core tubes, logged, and subsampled. The subsamples were then resubmitted to Multichem for selected analyses. It is this set of subsamples which were received at a temperature of 13.3 C° on May 13.

Issue:

The second paragraph of discussion indicates that original samples were relinquished by the sampler to the laboratory at 1750 on May 12, but were received by the laboratory at 1745.

Response:

This was a time difference between the wall clock in the laboratory and the samplers watch which was not noticed at the time of sample delivery. As to the date samples were relinquished, as previous stated all samples from this group were submitted to the laboratory on the day they were sampled.

SDG 805052

C-O-C and Sample Receipt Discussion

Issue:

The second paragraph of discussion indicates that two jars were received at Columbia analytical with no identification tags and that no sample was received for ammonia analysis.

Response:

MultiChem Analytical prepared a sample for ammonia analysis from surplus sample material stored in the cooler at that lab. This sample was shipped to Columbia with a copy of the original C-O-C marked up to indicate that this was a replacement sample for the one that was missing. The unlabelled bottles were disposed of at Columbia analytical.

SDG 805056

C-O-C and Sample Receipt Discussion

Issue:

The first paragraph of the discussion indicates that the samples were collected on May 12, 1998 and received at the laboratory on May 14 at a temperature of 8.7 C°.

Response:

The samples in this delivery group were submitted to the laboratory on the day they were collected. The samples were removed from the cooler at MultiChem on May 14 by Mark Otten of Foster Wheeler for subsampling. The subsamples were received back at MultiChem on May 14 at a temperature of 8.7 C°.

SDG 805086

C-O-C and Sample receipt Discussion

Issue:

The discussion indicates that chain-of-custody was not documented from sample collection to the delivery of the samples at the lab.

Response:

The samples in this delivery group were collected with SDG 805052 and the COC forms document this collection. Because these samples were designated for TBT analyses, they were given a new SDG and tracked separately. The COC for both SDGs are attached to provide this documentation.

SDG 805090

C-O-C and Sample receipt Discussion

Issue:

There were changes and obliterations on chain-of-custody with no initials and date.

Response:

Noted by Foster Wheeler

Issue:

There is a five day break in Chain-of-Custody from the time the samples were relinquished by MultiChem Analytical Services and when Columbia Analytical Services received the samples into the laboratory. There were no bills of lading or airbills to indicate a courier was used.

Response:

Multichem shipped the samples to Columbia via standard rather than priority Fed-X delivery on Friday. Consequently,the samples did not leave Seattle until Monday and arrived on Wednesday.

Issue:

Columbia Analytical did not provide any information regarding sample condition upon receipt.

Response:

Columbia did not include the cooler receipt in the data package. There were no anomalies and the temperature was 4.3° C upon receipt. Columbia is Faxing FWENC a copy of the cooler receipt. (Conversation with Richard Craven (CAS) 10/8/98).

SDG 805116

C-O-C and Sample receipt Discussion

Issue:

The Chain-of-Custody contains a gap in custody of about 24 hours, presumably for shipping from MAS to CAS. The waybills are not attached and neither lab noted that the samples were relinquished or received from a freight carrier.

Response:

These Samples were packed in a cooler and relinquished by STI on 5/28/98 at 3:00 pm with the COC inside the cooler. Steve Hoffman of STI dropped the sealed cooler of samples to MAS on 5/29/98 at 9:25 am. It is noted that the cooler was sealed with custody seals on the sample login form. STI should have relinquished the cooler to Steve Hoffman who then should have relinquished the cooler to MAS. Foster Wheeler was not notified of this error. MAS then re-packaged some samples and shipped them Fed-X to CAS.

SDG 806001

C-O-C and Sample receipt Discussion

Issue:

The Chain-of-Custody is incomplete. The samples were relinquished on May 29 by sampler but received on June 1 at MAS. The sample login checklist indicates hand delivery and no express shipment waybills are attached or referenced. The samples were then relinquished on June 1 and received by CAS on June 2, again with out referencing a waybill.

Response:

Same response as for SDG 805116.

Quality By Design

Laboratory Quality Assurance Consulting

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PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Dates of Sampling: May 29 & June 1, 1998
SDG No. 806010

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 011930
QBD Job No.: 121

Reviewed and Approved,

Thomas S. Davis 10/14/98

Thomas S. Davis, Principal Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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A. Introduction 2
B. Chain-of-Custody and Sample Receipt 4
C. Review of Organic Tin Analyses 5

Attachment 1 Data Evaluation

A. Introduction

Laboratory Sciences, Inc., d.b.a. *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 011930.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of one data package from Columbia Analytical Services in Kelso, Washington and contains data for the samples listed in Table 1.

Each data set includes an analytical data package for each sample, copies of the completed chain-of-custody forms, and a Quality Control (QC) Data Package. The analytical data package includes analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates but not times, detection limits, method references, surrogate recoveries as appropriate, the laboratory's name and address and the analyst's initials. The custody forms include the receipt of the sample but not the laboratory's internal tracking. The QC Data Package includes a tabular listing of the laboratory's sample identification, spiking concentrations, recoveries, percentage calculations, and acceptance windows. Supporting documentation includes chromatograms and instrumental printouts for the samples, QC checks and calibration.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SV	PEST	PCB	MET	INORG	TBT
MWST051R1	806010-1							X
MWST051R1S	806010-2							X
MWST048R1S	806010-3							X
MWST047R1S	806010-4							X
MWST060R1	806010-5							X
MWST060R1S	806010-6							X

Key:

VOA	=	Volatile Organic Compounds
SV	=	Semi-volatile Organic Compounds
PEST	=	Chlorinated Pesticides
PCB	=	Polychlorinated Biphenyls
MET	=	Trace Metals
INORG	=	Total Organic Carbon, Sulfide, Ammonia, and Grain Size
TBT	=	Tributyl Tin

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors were found.

C. Review of Organic Tin Analyses

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within laboratory or method criteria.

Discussion: A surrogate (Tripropyltin) was out of criteria in the blank associated with the other surrogate data. No data flags are recommended because the other surrogate in the blank and all of the surrogates in the samples were acceptable.

5. Matrix Spike/Matrix Spike Duplicate

Except as noted below, matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within laboratory or method criteria.

Discussion: The matrix spike extract was broken and lost during the analysis. The lab reported a second MS and MSD pair that was analyzed with this project's samples, but they should not be associated with the project samples because they were from a different extraction batch. However, no data qualifier flags are recommended because all results on the remaining MSD and the LCS were acceptable.

6. Field Duplicates

No field duplicates were identified with this group of samples.

7. TCL Compound Identification

No TCL Compounds were detected.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts.

Discussion: The chromatograms and worksheets used for processing the data include a calculation which converts butyl tin to the equivalent units as tin only. However, the laboratory reported the results of these samples in units of µg/L as mono-, di-, tri-, and tetra-Butyltin, as appropriate for each analyte.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Data Evaluation

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: 806010

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: October 14, 1998

No. of Samples: 6

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg	TBT
Holding Times	N/A	N/A	N/A	N/A	N/A	N/A	O
GC/MS Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Initial & Continuing Calibration	N/A	N/A	N/A	N/A	N/A	N/A	O
Field Blanks (F=N/A)	N/A	N/A	N/A	N/A	N/A	N/A	F
Laboratory Blanks	N/A	N/A	N/A	N/A	N/A	N/A	O
Surrogates	N/A	N/A	N/A	N/A	N/A	N/A	O
Matrix Spikes/Duplicates	N/A	N/A	N/A	N/A	N/A	N/A	O
QC Samples (LCS, PVS)	N/A	N/A	N/A	N/A	N/A	N/A	O
Internal Standards	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Identification	N/A	N/A	N/A	N/A	N/A	N/A	O
Compound Quantification	N/A	N/A	N/A	N/A	N/A	N/A	O
System Performance	N/A	N/A	N/A	N/A	N/A	N/A	O
Overall Assessment	N/A	N/A	N/A	N/A	N/A	N/A	O

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: None

DATA EVALUATION SUMMARY

SDG No. 806010

Date: October 14, 1998

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 6

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD	Internal Standards	Other	Total # of Analytes	Total # Estimated/Total # in all Samples
TBT								0	0/24 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MD/MSD	Internal Standards	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
TBT								0	0/24 = 0%

Note: Asterisk (*) indicates additional exceedances of review criteria.

BIOLOGICAL DATA VALIDATION

AMPHIPOD BIOASSAY QA REVIEW

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Memorandum

Date: September 30, 1998

To: Middle Waterway File (1699.0010.0008)

From: G. Braun

RE: Middle Waterway Amphipod Bioassay – QA Review

SUMMARY OF DATA QUALITY

Overall, the amphipod bioassays performed for the Round 1A Sampling and Analysis of the Middle Waterway Problem Area of the Commencement Bay/Nearshore Tideflats Superfund Site followed the recommended Puget Sound Estuary Program (PSEP) protocols and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). The data are considered acceptable without qualification.

SAMPLE COLLECTION, TRANSPORT, AND CHAIN-OF-CUSTODY

Sediment samples were collected at ten stations within Middle Waterway, at three reference stations (located in Carr Inlet), and at a control site (West Beach, Whidbey Island). These sediment samples were delivered to Northwest Aquatic Services laboratory for sediment toxicity tests using the amphipod *Rhepoxynius abronius*. Sediment samples were delivered to the NAS laboratory in four batches on May 18, 20, 21, and 28, 1998. Compliance with quality assurance (QA) and chain-of-custody procedures for the collection and transport of sediment samples were maintained.

Methods for collection, transport, and handling of test amphipods were appropriate. Amphipods were collected for bioassays on May 25, 1998. The amphipods were dredged at West Beach (Whidbey Island, Washington), placed in plastic buckets that contained a 2-cm layer of sediment and seawater from the collection site, and transported to the laboratory via overnight delivery.

STORAGE AND HOLDING TIMES

Sediment storage and holding times were appropriate and followed recommendations of the PSEP protocols and the SAP (Foster Wheeler Environmental 1998). Sediments were stored at 4°C in the dark for 1-11 days before toxicity testing (Table 1).

Table 1. Dates and Holding Times for Amphipod Bioassays

	Bioassay Sediment Types				
	Control (Whidbey Island)	**MW022-MW025**	**MW040, MW049, Mw054**	**Mwo39, MW043, MW048, MW053**	**Carr Inlet (MW208, MW209, MW210)**
Amphipods collected	May 25, 1998				
Amphipods received	May 27, 1998				
Sediment collected	May 25, 1998	May 15, 1998	May 18, 1998	May 19, 1998	May 22, 1998
Sediment received	May 27, 1998	May 18, 1998	May 20, 1998	May 21, 1998	May 28, 1998
Bioassay started	May 29, 1998	May 29, 1998	May 29, 1998	May 29, 1998	May 29, 1998
Bioassay ended	June 8, 1998	June 8, 1998	June 8, 1998	June 8, 1998	June 8, 1998

Amphipod culture and holding times were appropriate and followed recommendations of the PSEP protocols and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). Amphipods were acclimated to laboratory conditions for two days prior to toxicity testing. During this acclimation period, average conditions were: temperature 13.2± 4.7° C; salinity 29.7± 0.6 ppt; dissolved oxygen 5.7 ±2.8 mg/L; pH 7.4 ± 0.3; photoperiod, constant illumination.

INTERSTITIAL SALINITY

Interstitial salinity is a variable that can affect amphipod bioassay results. Interstitial salinity for each test sediment and for the positive control sediment was measured with a refractometer. Interstitial salinities were typically > 25 ppt, and did not require adjustment. The following minor issues are associated with interstitial salinity data:

- Interstitial salinity for test sediment samples MWAT048R1 and MWAT052R1 had interstitial salinities below 25 ppt (i.e., 24 ppt) and were adjusted to increase the interstitial salinity as per PSEP (1995).
- There was insufficient water available for interstitial salinity measurement in test sediment sample MWAT054R1. This station is located at the head of the waterway and near to several other stations. The location of this sample indicates that interstitial salinity should be approximately the same as that in adjacent samples, which ranged from 24 to 28.5 ppt. Based on these considerations, the bioassay data for this station are considered acceptable.

BIOASSAY METHODS

Sediment bioassays consisted of amphipod exposure to sediments collected at ten test stations in Middle Waterway, three reference stations from Carr Inlet, and clean control sediments collected at West Beach on Whidbey Island. Positive control bioassays

consisted of amphipod exposure to a reference toxicant (i.e., cadmium chloride) dissolved in seawater.

Sediment Bioassays

The testing apparatus, test procedures, volume of test sediments, numbers of analytical replicates, number of organisms per replicate, and duration of bioassays were appropriate and followed recommendations of the PSEP protocols and the EPA-approved SAP Foster Wheeler 1998).

Bioassays were conducted on five analytical replicates of each test, reference, and control sediment. In addition, each treatment also included one water quality replicate and two sacrificial replicates for day 0 and day 5 for interstitial ammonia and sulfide measurements. A negative control sediment was run concurrently with the test sediments. For each replicate, 175 ml of test or control sediment was placed in the bottom of a 1-L borosilicate glass beaker and covered with seawater to obtain a total volume of 950 ml. Seawater used in the bioassays was obtained from Yaquina Bay, Oregon on May 28, 1998. The seawater was filtered ($\leq$ 40 um) and had a salinity of 27.0 ppt and a pH of 7.5. Each container was then placed in random order in a water bath under constant temperature and illumination. Aerated, and left undisturbed overnight. The bioassay was then started by seeding each container with 20 amphipods. Test containers were checked daily to establish early trends in mortality and sediment avoidance (i.e., amphpod emergence), and also to gently sink any amphipods that had left the sediments overnight and become trapped by surface tension at the air-water interface. One of the replicate containers for each sediment bioassay was used for daily measurements of water chemistry (i.e., temperature, salinity, dissolved oxygen, and pH). Ammonia-N and sulfide were measured in the overlying water of one replicate test chamber on days 0 and 10. In addition, ammonia-N and sulfide were measured in the pore water of one replicate test chamber per treatment on days 0, 5, and 10.

For each sediment bioassay, the temperature in the water chemistry containers averaged 15.2 $\pm$ 0.3°C throughout the 10-day test. This temperature was within the range (15 $\pm$ 1° C) specified in the PSEP protocols. The average overlying salinity was 28.1 $\pm$ 0.7, which was within the range specified in the PSEP protocols. The overlying salinity was slightly below the specified limits in one water quality beaker on day two of the test (26.5 ppt) and higher in three beakers on day 10 (30 ppt). These deviations are not considered to be serious and should not adversely affect the test results. Dissolved oxygen concentrations in the various bioassay treatments ranged from 7.2 to 8.3 mg/L during the 10-day test period, and were well above the minimum (i.e., >5 mg/L) specified in the protocols. The pH levels in the various bioassays were also within the pH range specified in the protocols (i.e., 8 $\pm$ 1), averaging 8.0 $\pm$ 0.2.

Positive Controls

A reference toxicant bioassay was conducted in parallel with the sediment bioassays. In the reference toxicant bioassay, amphipods were exposed to six concentrations (i.e., 0, 0.1, 0.3, 1.0, 3.0, and 10.0 mg/L) cadmium chloride in seawater. Twenty amphipods

were exposed to each toxicant concentration (i.e., 10 amphipods/replicate, two replicates/treatment) for 96 hours. At the end of the exposure period, the numbers of living and dead animals were counted. The result of the reference toxicant test gave a 96-h LC50 value of 0.16 mg/L Cd. This result was within the laboratory's control chart warning limits (0.0-2.83 mg/L Cd).

REFERENCES

Foster Wheeler Environmental. 1998. Sampling and Analysis Plan and Quality Assurance Project Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee.

PSEP (Puget Sound Estuary Program). 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared Washington Department of Ecology for U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA and Puget Sound Water Quality Authority, Olympia, WA.

JUVENILE POLYCHAETE BIOASSAY QA REVIEW

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Memorandum

Date: September 30, 1998

To: Middle Waterway File (1699.0010.0008)

From: G. Braun

RE: Middle Waterway Juvenile Polychaete Bioassay – QA Review

SUMMARY OF DATA QUALITY

Overall, the juvenile polychaete bioassays performed for the Round 1A Sampling and Analysis of the Middle Waterway Problem Area of the Commencement Bay/Nearshore Tideflats Superfund Site followed the recommended Puget Sound Estuary Program (PSEP) protocols, with modifications as specified by the Puget Sound Dredge Disposal Analysis Program (PSDDA, now Dredge Material Management Program or DMMP) and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). The data are considered acceptable without qualification.

SAMPLE COLLECTION, TRANSPORT, AND CHAIN-OF-CUSTODY

Sediment samples tested with the juvenile polychaete bioassay were collected at four stations within Middle Waterway, at two reference stations (located in Carr Inlet), and at a control site (Yaquina Bay, Oregon). These sediment samples were delivered to Northwest Aquatic Services laboratory for sediment toxicity tests using the juvenile polychaete *Neanthes* sp. Sediment samples were delivered to the NAS laboratory in three batches on May 18, 20, and 28, 1998. Compliance with quality assurance (QA) and chain-of-custody procedures for the collection and transport of sediment samples were maintained.

Methods for collection, transport, and handling of test organisms were appropriate. Test organisms (2-3 week post emergence juveniles on receipt) were ordered from laboratory cultures maintained at the Department of Biology, California State University, Long Beach, California. Test worms were received on July 1, 1998. Control sediment was collected by NAS, from Yaquina Bay, Oregon on July 1, 1998. The sediment was sieved through a 1.0-mm screen, homogenized, and stored in the dark until used in the test.

STORAGE AND HOLDING TIMES

Sediment storage and holding times were appropriate and followed recommendations of the PSEP protocols and the SAP (Foster Wheeler Environmental 1998). Sediments were stored at 4°C in the dark for 2-49 days before toxicity testing (Table 1).

Table 1. Dates and Holding Times for Juvenile Polychaete Bioassays

	Bioassay Sediment Types			
	Control (Yaquina Bay)	**MW022, MW024, MW025**	**MW040**	**Carr Inlet (MW208, MW209)**
Polychaetes received	July 1, 1998			
Sediment collected	July 1, 1998	May 15, 1998	May 18, 1998	May 22, 1998
Sediment received	July 1, 1998	May 18, 1998	May 20, 1998	May 28, 1998
Bioassay started	July 3, 1998	July 3, 1998	July 3, 1998	July 3, 1998
Bioassay ended	July 23, 1998	July 23, 1998	July 23, 1998	July 23, 1998

Juvenile polychaete acclimation and holding times were appropriate and followed recommendations of the PSEP protocols and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). Juvenile polychaetes were acclimated to laboratory conditions for two days prior to toxicity testing. During this acclimation period, average conditions were: temperature 20.3 $\pm$ 0.7° C; salinity 31.5 $\pm$ 2.2 ppt; dissolved oxygen 6.2 $\pm$ 0.7 mg/L; pH 7.7 $\pm$ 0.2; photoperiod, 16:8 hr. L:D.

INTERSTITIAL SALINITY

- Interstitial salinity is a variable that can affect the bioassay results. Interstitial salinity for each test sediment and for the positive control sediment was measured with a refractometer. Interstitial salinities were all > 25 ppt, and did not require adjustment.

BIOASSAY METHODS

Sediment bioassays consisted of juvenile polychaete exposure to sediments collected at four test stations in Middle Waterway, two reference stations from Carr Inlet, and clean control sediments collected from Yaquina Bay, Oregon. Positive control bioassays consisted of juvenile polychaete exposure to a reference toxicant (i.e., cadmium chloride) dissolved in seawater.

Sediment Bioassays

The testing apparatus, test procedures, volume of test sediments, numbers of analytical replicates, number of organisms per replicate, and duration of bioassays were appropriate

and followed recommendations of the PSEP protocols (PSEP 1995) and the EPA-approved SAP Foster Wheeler 1998).

Bioassays were conducted on five analytical replicates of each test, reference, and control sediment. In addition, each treatment also included one water quality replicate and two sacrificial replicates for day 0 and day 10 for interstitial ammonia and sulfide measurements. A negative control sediment was run concurrently with the test sediments. For each replicate, 175 ml of test or control sediment was placed in the bottom of a 1-L borosilicate glass beaker and covered with seawater to obtain a total volume of 950 ml. Seawater used in the bioassays was obtained from Yaquina Bay, Oregon on July 2, 1998. The seawater was filtered ($\leq$ 40 um) and had a salinity of 28.0 ppt and a pH of 7.7. Each container was covered then placed in random order in a water bath under constant temperature and illumination, aerated, and left undisturbed overnight. The bioassay was then started by seeding each container with 5 juvenile polychaetes. Test containers were checked daily to ensure that adequate aeration was provided and to note the general status of each test chamber. The test duration was 20 days and animals were fed 40 mg TetraMarin per beaker every other day. One third of the seawater in each beaker was replaced every third day. One of the replicate containers for each sediment bioassay was used for measurements of water chemistry (i.e., temperature, salinity, dissolved oxygen, and pH) on test days 3, 6, 9, 12, 15, and 18 prior to test solution renewal. Ammonia-N was measured in the overlying water of one replicate test chamber on days 0, 3, 6, 9, 12, 15, 18, and 20. Ammonia-N and sulfide were measured in the pore water of the bulk sediments upon receipt, and in the interstitial water of one replicate sacrificial beaker on day 0. In addition, ammonia-N was measured in the interstitial water of additional sacrificial beakers on days 11 and 20. Sulfide was not measured because no sulfide was detected in any test sediment on day 0.

For each sediment bioassay, the temperature in the water chemistry containers averaged 20.4 $\pm$ 0.2° C throughout the 10-day test. This temperature was within the range (20 $\pm$ 1° C) specified in the PSEP protocols. The average overlying salinity was 28.5 $\pm$ 0.6, which was within the range specified in the PSEP protocols. Dissolved oxygen concentrations in the various bioassay treatments ranged from 5.9 to 7.2 mg/L during the 20-day test period, and were well above the minimum (i.e., >4 mg/L) specified in the protocols. The pH levels in the various bioassays were also within the pH range specified in the protocols (i.e., 8 $\pm$ 1), averaging 8.1 $\pm$ 0.2. No sulfides were detected in the overlying water either at the beginning or end of the test. Ammonia-N in the overlying water ranged from 0.2 to 8.0 mg/L.

The initial average worm weight was 0.18 mg dry weight, which is lower than the 0.5 to 1.0 mg that PSEP suggests indicates 2-3 week post-emergence juvenile worms. The worms were ordered from the only available supplier and specified to be 2-3 week post-emergence upon receipt. As part of the protocol, the initial weight of the worms is not known until after the test is initiated, as a random subset of the worms are dried to determine the average individual dry weight. Calculation of the individual growth rate for the controls indicated 0.68 mg/day which indicates that the worms were in a rapid growth phase during testing; which is the intent of using 2-3 week post-emergence

animals. In addition, the reference toxicant (positive control) test result (discussed below) was in the middle of the laboratory's control chart for this species. Therefore, this test is considered acceptable without qualification.

Positive Controls

A reference toxicant bioassay was conducted in parallel with the sediment bioassays. In the reference toxicant bioassay, juvenile polychaetes were exposed to six concentrations (i.e., 0, 1.56, 3.13, 6.25, 12.5, and 25.0 mg/L) cadmium chloride in seawater. Twenty polychaetes were exposed to each toxicant concentration (i.e., 10 individuals/replicate, two replicates/treatment) for 96 hours. At the end of the exposure period, the numbers of living and dead animals were counted. The result of the reference toxicant test gave a 96-h LC50 value of 7.6 mg/L Cd. This result was within the laboratory's control chart warning limits (2.73 – 14.0 mg/L Cd).

REFERENCES

Foster Wheeler Environmental. 1998. Sampling and Analysis Plan and Quality Assurance Project Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee.

PSEP (Puget Sound Estuary Program). 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared Washington Department of Ecology for U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA and Puget Sound Water Quality Authority, Olympia, WA.

LARVAL BIOASSAY QA REVIEW

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Memorandum

Date: September 30, 1998

To: Middle Waterway File (1699.0010.0008)

From: G. Braun

RE: Middle Waterway Larval Bioassay – QA Review

SUMMARY OF DATA QUALITY

Overall, the larval bioassays performed for the Round 1A Sampling and Analysis of the Middle Waterway Problem Area of the Commencement Bay/Nearshore Tideflats Superfund Site followed the recommended Puget Sound Estuary Program (PSEP) protocols and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). The data are considered acceptable without qualification.

SAMPLE COLLECTION, TRANSPORT, AND CHAIN-OF-CUSTODY

Sediment samples were collected at ten stations within Middle Waterway and at three reference stations (located in Carr Inlet). These sediment samples were delivered to Northwest Aquatic Services laboratory for sediment toxicity tests using the blue mussel *Mytilus* sp. Sediment samples were delivered to the NAS laboratory in four batches on May 18, 20, 21, and 28, 1998. Compliance with quality assurance (QA) and chain-of-custody procedures for the collection and transport of sediment samples were maintained.

Methods for collection, transport, and handling of test mussels were appropriate. Mussels were collected from Yaqunia Bay, Oregon and transported to the laboratory and used immediately for bioassays on June 4, 1998. A total of 8 female and 4 male mussels were collected and used to provide gametes for the bioassays.

STORAGE AND HOLDING TIMES

Sediment storage and holding times were appropriate and followed recommendations of the PSEP protocols and the SAP (Foster Wheeler Environmental 1998). Sediments were stored at 4°C in the dark for 13-20 days before toxicity testing (Table 1).

Table 1. Dates and Holding Times for Amphipod Bioassays

	Bioassay Sediment Types				
	Yaqunia Bay	**MW022-MW025**	**MW040, MW049, Mw054**	**Mwo39, MW043, MW048, MW053**	**Carr Inlet (MW208, MW209, MW210)**
Mussels collected	June 4, 1998				
Mussels spawned	June 4, 1998				
Sediment collected		May 15, 1998	May 18, 1998	May 19, 1998	May 22, 1998
Sediment received		May 18, 1998	May 20, 1998	May 21, 1998	May 28, 1998
Bioassay started	June 4, 1998	June 4, 1998	June 4, 1998	June 4, 1998	June 4, 1998
Bioassay ended	June 6, 1998	June 6, 1998	June 6, 1998	June 6, 1998	June 6, 1998

Mussel holding times were appropriate and followed recommendations of the PSEP protocols and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). Adult mussels were collected and spawned on the same day to produce gametes for the toxicity test.

INTERSTITIAL SALINITY

Interstitial salinity for each test and reference sediment was measured with a refractometer. Interstitial salinities were typically > 25 ppt, and did not require adjustment.

BIOASSAY METHODS

Sediment bioassays consisted of 1.0-hour post fertilization mussel larvae exposure to sediments collected at ten test stations in Middle Waterway, three reference stations from Carr Inlet, and a Yaqunia Bay seawater control. Positive control bioassays consisted of larval exposure to a reference toxicant (i.e.,copper sulfate) dissolved in seawater.

Sediment Bioassays

The testing apparatus, test procedures, volume of test sediments, numbers of analytical replicates, number of organisms per replicate, and duration of bioassays were appropriate and followed recommendations of the PSEP protocols and the EPA-approved SAP Foster Wheeler 1998).

Bioassays were conducted on five analytical replicates of each test, reference, and seawater control. In addition, each treatment also included one water quality replicate. A seawater control was run concurrently with the test sediments. For each replicate, 18 g of test sediment was placed in a 1-L borosilicate glass beaker and covered with seawater to obtain a total volume of 900 ml. Seawater used in the bioassays was obtained from Yaquina Bay, Oregon on May 28, 1998. The seawater was filtered (≤ 40 um) and had a

salinity of 28.0 ppt and a pH of 7.9. Each container was vigorously mixed for 10 seconds and allowed to settle for 4 hours. Each container was then placed in random order in a water bath under constant temperature and a photoperiod of 14:10 L:D. Aeration was provided by slow bubbling at least 2 cm above the sediment surface. The bioassay was initiated by inoculating each container with 10 ml of the 1-hour post fertilization larval stock solution. The use of an inoculation volume of 10 ml is higher than the 1.0 ml specified in the PSEP protocols, however, the inoculation stock solution was also more dilute. The initial concentration of test organisms was 32.2/ml. Therefore, this minor deviation is unlikely to have adversely affected the test results. One of the replicate containers for each sediment bioassay was used for daily measurements of water chemistry (i.e., temperature, salinity, dissolved oxygen, and pH). Ammonia-N and sulfide were measured in the overlying water of one replicate test chamber on days 0 and 2.

For each sediment bioassay, the temperature in the water chemistry containers averaged 15.1 $\pm$ 0.1°C throughout the test. This temperature was within the range (15 $\pm$ 1°C) specified in the PSEP protocols. Temperature was recorded as 14.9 C in two monitoring beakers on the last day of the test. This minor deviation should not adversely affect the test results. The average overlying salinity was 27.6 $\pm$ 0.7, which was within the range specified in the PSEP protocols. Dissolved oxygen concentrations in the various bioassay treatments averaged 7.1 $\pm$ 1.3 mg/L during the test period, and were well above the minimum (i.e., >4 mg/L) specified in the protocols. The pH levels in the various bioassays were also within the pH range specified in the protocols (i.e., 8 $\pm$ 1), averaging 7.8 $\pm$ 0.1. Sulfides were not detected in the overlying water at either the beginning or the end of the test. Total ammonia-N was detected in one beaker at the beginning of the test (0.2 mg/L) and at the end of the test (0.3 mg/L).

A total of 10 test replicate subsamples were recounted (QC counts) by a second investigator as a QC check on the acceptability of the initial counts. In all instances the QC counts were close to the initial counts (i.e., CV from 0 to 3) and were considered acceptable. The test was considered acceptable because 82.5% of the inoculated embryos (32.2/ml based on average counts of zero time samples) produced normal larvae in the seawater control. This exceeds the test acceptance criteria of > 70% normal as specified in the protocols.

Positive Controls

A reference toxicant bioassay was conducted in parallel with the sediment bioassays. In the reference toxicant bioassay, larvae were exposed to eight concentrations (i.e., 0, 1, 2, 4, 8, 16, 32, and 64 mg/L) copper sulfate. Two replicates of 10 ml of larval stock were exposed to each toxicant concentration (i.e., 10 ml/replicate, two replicates/treatment) for 48 hours. At the end of the exposure period, the numbers of abnormal and dead animals were counted. The result of the reference toxicant test gave a 48-h EC50 value of 11.4 mg/L Cu. This result was within the laboratory's control chart warning limits (8.7-11.8 mg/L Cu).

REFERENCES

Foster Wheeler Environmental. 1998. Sampling and Analysis Plan and Quality Assurance Project Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee.

PSEP (Puget Sound Estuary Program). 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared Washington Department of Ecology for U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA and Puget Sound Water Quality Authority, Olympia, WA.

BENTHIC INFAUNA QA REVIEW

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Memorandum

Date: September 30, 1998

To: Middle Waterway File (1699.0010.0008)

From: G. Braun

RE: Middle Waterway Benthic Infauna – QA Review

SUMMARY OF DATA QUALITY

The sampling and analysis of benthic infauna assemblages for the Round 1A Sampling and Analysis of the Middle Waterway Problem Area of the Commencement Bay/Nearshore Tideflats Superfund Site followed the recommended Puget Sound Estuary Program (PSEP) protocols and the EPA-approved Sampling and Analysis Plan (Foster Wheeler Environmental 1998). The data are considered acceptable without qualification.

SAMPLE COLLECTION, TRANSPORT, AND CHAIN-OF-CUSTODY

Benthic macroinvertebrates were collected at ten stations within Middle Waterway and at five reference stations (two near the mouth of the Sitcum/Milwaukee Waterway and three in the Hylebos Waterway). Four of the ten test stations in Middle Waterway and the two reference stations near the Sitcum Waterway were not analyzed and were archived. The remaining six Middle Waterway and reference stations were located within the intertidal area of each waterway and were analyzed for benthic infauna.

Seven replicate grab samples were collected at each station, for a total of 105 samples. All grab samples were collected using a 0.023-m^2 petite Ponar grab sampler. In the field, samples were washed on a sieve with 1.0-mm mesh openings and fixed with a 10 percent solution of buffered formalin. Sample tracking records followed each sample through all stages of sample collection and laboratory processing.

The field sampling methods used to collect benthic macroinvertebrate samples during the Round 1A survey are outlined in the SAP (Foster Wheeler Environmental 1998) and the PSEP protocols. The following discussion summarizes those procedures.

Following deployment and retrieval of the grab sampler, the sediment sample was inspected carefully to determine the acceptability of the sample. Samples were rejected if they did not meet the acceptance criteria.

When a sample was judged to be acceptable, the following qualitative sediment characteristics were recorded:

- Penetration depth
- Sediment texture
- Sediment color
- Presence and strength of odors
- Degree of leakage and/or surface disturbance
- Presence of debris or shell fragments.

Field log sheets for all stations are provided in Appendix ???.

After these observations were recorded, the sampler was opened and the sediment was released into a clean bucket containing a label identifying the sample. The sampler was rinsed so that all sediment from the sampler was contained in the bucket. The sediment from each bucket was rinsed into a sieve box and the sample material was then completely washed until material no longer passed through the 1.0-mm mesh screen. That portion of the sample retained on the screen was then placed in a plastic sample bag having both internal and external labels. Samples were then fixed in the field with a 10 percent solution of buffered formalin.

LABORATORY ANALYSIS

In the laboratory, benthic invertebrate samples were washed on a 0.5-mm sieve and transferred to a 70 percent solution of alcohol. The rescreening process was performed by Marine Taxonomic Services, Ltd. (MTS).

Of the 105 samples (i.e., 15 stations) collected, 42 samples (i.e., six stations) were archived and not processed. In addition, replicates six and seven from each of the remaining stations were also archived and have not been processed. The remaining 45 samples (i.e., replicates 1-5 from each remaining station) were processed by MTS. Project personnel who sorted and identified the samples are identified in the material received from MTS dated August 21, 1998. Organisms were identified to the lowest practical taxonomic level. Planktonic organisms that occurred in the samples were not enumerated, but were given an abundance of "1" to note their presence in the sample. Specimens of each species (or lowest practical taxon) that occurred in the survey were placed in a reference collection prepared by the taxonomists.

QUALITY ASSURANCE/QUALITY CONTROL

Quality control (QC) checks of sample sorting were performed by resorting 20 percent of each sample. If the 20 percent resort indicated a calculated difference of 5.0 percent or greater in total sample abundance for all taxa combined, the entire sample was resorted. Quality control checks of taxonomic identifications were performed by having one expert taxonomist re-identify 5 percent of another taxonomist's samples. All specimens placed in the reference collection, were also compared with specimens in the taxonomists voucher collection from organisms identified in Puget Sound.

Howard Jones, of MTS, entered the benthic infauna data from the taxonomist's original laboratory data sheets onto an electronic spreadsheet (e.g. Excel). NODC taxonomic codes were included for most taxa. All entries in the spreadsheet were verified against the original laboratory sheets after data entry. The hard copies of the data set were reviewed for errors. None were found.

QA/QC procedures resulted in an acceptable data set without qualification.

DATA DELIVERABLES

On August 25, 1998, Foster Wheeler received the following from MTS: diskettes containing the spreadsheets of data for the nine stations, hard copy of the data for the same stations, an invertebrate species checklist, bulk QA report, voucher collection and QA report, benthic sorting QC report, and biomass report. This submittal did not include information on the crustacean QA. The same set of reports, but with the results of the crustacean QA were received on September ??, 1998.

A checklist of all taxa identified for the project was received, and the list was reviewed for accuracy. The QA results from various taxonomists were also provided, and it appeared that the QA information provided by MTS to Foster Wheeler was accurate. The reference collection and buckets containing the vials of sorted residue will be submitted to Foster wheeler at a later date.

REFERENCES

Foster Wheeler Environmental. 1998. Sampling and Analysis Plan for the Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats Superfund Site. Prepared for the Middle Waterway Action Committee. Foster Wheeler Environmental Corporation, Bellevue, WA.

Puget Sound Estuary Program. 1996. Recommended protocols for sampling and analyzing subtidal benthic macroinvertebrate assemblages in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA. Prepared by Tetra Tech, Inc., Bellevue, WA. 30 pp.

APPENDIX E

Note: Please add the following pages at the end of Appendix E.

4/26/99

Quality By Design

Laboratory Quality Assurance Consulting

97 Puhili Street
Hilo, Hawaii 96720

Phone: (808) 969-9424
Fax: (808) 969-9094

PSEP
DATA VALIDATION REPORT

Project Name: Middle Waterway Problem Area
Type of Samples: Water and Sediments
Dates of Sampling: Various
SDG No.: Various

Prepared for:

Foster Wheeler Environmental Corporation
10900 N.E. 8th Street, Suite 1300
Bellevue, WA 98004-4405

Purchase Order Number: 017034
QBD Job No. 178

Reviewed and approved:

Thomas S. Davis 4/26/99

Thomas S. Davis, Principal — Date

Table of Contents

This data validation report consists of the following stand alone sections, each of which is formatted to follow Functional Guidelines but which also include subsections discussing QBD contacts with the laboratory, other comments, and a summary table of data qualifiers.

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Attachment 1 Puget Sound Estuary Program Data Qualifier Definitions
Attachment 2 Data Qualification Summary
Attachment 3 Data Evaluation Summary
Attachment 4 Communications with the Laboratory
Attachment 5 Revised Laboratory Reports

A. Introduction

Laboratory Sciences, Inc., dba *Quality by Design*, has completed a PSEP Data Validation on the submitted data packages in accordance with Foster Wheeler Environmental Corporation Purchase Order Number 017034.

The reporting format and criteria for recommending data qualifying flags for this data set are described in USEPA *"Functional Guidelines for Evaluating Organics Analyses"*, *"Functional Guidelines for Evaluating Inorganics Analyses"*, as revised, December, 1994, and *"Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound"*, May 1997, or using criteria listed in the method referenced. Data may be qualified for any of several reasons:

1. By the laboratory prior to receipt by the reviewer;
2. Because of laboratory deviation from the designated method;
3. Because the data may not meet the criteria listed in the reference above; or
4. By the professional judgment of the reviewer.

The data set consists of 35 data packages from MultiChem Analytical Services in Renton, Washington and contains data for the samples shown in Table 1. The data reviewer and the senior reviewer for each package are shown in Table 2.

Each data set consists of a complete set of Contract Laboratory Protocol forms or Contract Laboratory Protocol equivalent forms and the accompanying raw data, which included chromatograms, instrument printouts, injection logs, digestion/preparation logs, and standard logs.

Table 1: Sample Identification and Analysis

Sample Identification	Laboratory Identification	VOA	SVOA	Pest	PCB	Met	TOC	Inorg
TCLT-PV Rinsate	806099-1 through -5		X	X		X	X	
TCLT-PV1-6/29/98	806099-6		X	X				
DPC-METT-7/2/98	807014-1		X	X		X	X	
DPC-METD-7/2/98	807014-2		X	X		X	X	
DPC-DRET-7/2/98	807014-3		X	X		X	X	
DPC-WATT-7/2/98	807014-4		X	X		X	X	
DPC-WATD-7/2/98	807014-5		X	X		X	X	
DPC-DUPL-7/2/98	807014-6		X	X		X	X	
DPC-BKS1-7/1/98	807014-7	X	X	X	X	X	X	X
TCLT-PV 1.5	807014-8					X		
TCLT-PV 3.0	807030-1					X		
TCLT-PV 2.5	807030-2		X	X		X		
TCLT-PV 4.0	807046-1		X	X				
TCLT-PV 5.0	807073-1					X		
TCLT-PV 6.0	807093-1		X	X				
TCLT-PV 6.3	807099-1					X		
TCLT-PV 7.3	807110-1		X	X				
TCLT-PV 8.0	808010-1					X		
TCLT-PV 9.0	808027-1		X	X				
TCLT-PV 10	808053-1					X		
TCLT-PV 11	808058-1		X	X				
TCLT-PV 11.5	808067-1					X		
TCLT-PV 12.8	809004-1		X	X				
TCLT-PV 13.4	809010-1					X		
TCLT-PV 14.4	809025-1			X				
TCLT-PV 14.9	809047-1					X		
TCLT-PV 15.8	809060-1		X	X				
TCLT-PV 16.5	809068-1					X		

Sample Identification	Laboratory Identification	VOA	SVOA	Pest	PCB	Met	TOC	Inorg
TCLT-PV 17.5	809077-1		X	X				
TCLT-PV 18.0	810003-1					X		
TCLT-PV 19.0	810020-1		X	X				
TCLT-PV 19.6	810029-1					X		
TCLT-PV 20.6	810054-1		X	X				
TCLT-PV 21.2	810054-2					X		
TCLT-PV 27.4	810077-1					X		
TCLT-PV 22.2	810089-1		X	X				
TCLT-PV 22.9	810096-1					X		
TCLT-PV 23.8	811011-1		X	X				
TCLT-PV 24.3	811023-1					X		
TCLT-PV 25.3	811034-1		X	X				
TCLT-PV 25.9	811049-1					X		
TCLT-PV 26.9	811066-1		X	X				
TCLT-PV 28.4	812003-1		X	X				
TCLT-PV 29.1	812003-2					X		
TCLT-PV 30.0	812013-1		X	X				
TCLT-PV 32.9	812045-1					X		

Key:

VOA = Volatile Organic Compounds
SVOA = Semivolatile Organic Compounds
Pest = Chlorinated Pesticides
PCB = Polychlorinated Biphenyls
Met = Trace Metals
Inorg = Sulfide, Ammonia
TOC = Total Organic Carbon

Table 2: Data Package, Reviewer, and Senior Reviewer

Analysis	Reviewer	Senior Reviewer
Volatile Organics	Debbie Copsey	Thomas S. Davis
Semivolatile Organics	Debbie Copsey	Thomas S. Davis
Pesticides	Randi Schneider	Thomas S. Davis
PCBs	Randi Schneider	Thomas S. Davis
Metals	Carlene McCutcheon	Thomas S. Davis
Inorganics	Carlene McCutcheon	Thomas S. Davis
TOC	Carlene McCutcheon	Thomas S. Davis
Sample Receiving	Randi Schneider	Thomas S. Davis

B. Chain-of-Custody and Sample Receipt

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors were found.

Discussion: The coolers that contained the following five samples were received at temperatures above the acceptance criteria of 4 ± 2 °C. The coolers showed evidence of cooling, and since these analyses are not highly volatile, it is the judgment of the reviewer that the impact of this exceedence does not warrant a data qualifier flag.

Temperature	Analytes Affected	Associated Samples
7.9 °C	Semivolatiles, Pesticides, TOC, Metals	TCLT-PV1 6/29/98
7.9	Semivolatiles, Pesticides, TOC, Metals	TCLT-Rinsate
7.5	Semivolatiles, Pesticides	TCLT-PV 7.3
7.0	Metals	TCLT-PV 10
10.1	Semivolatiles, Pesticides	TCLT-PV 12.8

Virtually all of the samples had a gap in the chain-of-custody for the shipping to MultiChem Analytical Services (MAS). The custody forms were relinquished but were not noted as being shipped, so that the "received by" signature block was that of MAS. For several samples, MAS attached a copy of the shipping label, which contains the waybill number. MAS noted the time and date received on all custody forms and noted on the sample condition upon receipt forms that the sample had been received from a courier or commercial shipper.

C. Review of GC/MS Volatiles Analyses

EPA Method 8260B

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Form I for the semivolatile results for Sample TCLT-PV 2.5 lists the date sampled as 7/8/98. It was corrected to 7/5/98 and a copy is attached to this report.

2. GC/MS Tuning

All Bromofluorobenzene (BFB) tune criteria were met for the initial calibration and all dates of sample analysis.

3. Initial and Continuing Calibration

All initial calibration and continuing QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

4. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

5. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within QAPP or method criteria.

6. Matrix Spike/Matrix Spike Duplicate

Blank spikes, matrix spikes (MS), and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries and relative percent differences were within QAPP or method criteria.

Discussion: The relative percent difference between the MS and the MSD associated with Sample DPC-BKS1-7/1/98 for 1,2,4-trichlorobenzene was incorrectly reported as 9. The correct value is 7, which is within acceptance criteria, and no data qualifier flags are recommended.

7. Field Duplicates

No field duplicates were identified.

8. Internal Standards Performance for Samples

All internal standard areas were within the required control limits.

9. TCL Compound Identification

No TCL Compounds were detected.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF. Reporting limits have been correctly adjusted for dilutions and extraction amounts, and meet the requirements of the contract.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

There was no verbal or written communication with the laboratory.

14. Other Comments

None.

15. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

D. Review of GC/MS Semivolatiles Analyses

EPA Method 8270C

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Discussion: Chromatograms and raw data for the continuing calibration standards were missing from several of the data packages. The laboratory was contacted and provided fax copies of the data to the reviewer and directly to Foster Wheeler, copies of which are attached to this report.

2. GC/MS Tuning

All Decafluorotriphenylphosphine (DFTPP) tune criteria were met for the initial calibration and all dates of sample analysis.

Discussion: PSEP and earlier versions of the referenced method state that all samples must be completed within the twelve hour clock which starts with the DFTPP tune check. Sample TCLT-PV 4.0 exceeded this 12 hour time period by eight minutes. However, both recent USEPA guidance and the most recent version of the method clarify that the sample analysis must start within the 12-hour period. The analysis of this sample meets this updated criterion and no data qualifier flags are recommended.

3. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations greater than that allowed by the method and all System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) criteria were met.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 19.0	Acenaphthene	Continuing Calibration	4.3 G
TCLT-PV 22.2	Pentachlorophenol	Continuing Calibration	1.9 UG
TCLT-PV 30.0	Acenaphthene	Continuing Calibration	3.8 G
DPC-BKS1-7190	Benzyl alcohol	Continuing Calibration	2.1 G
DPC-BKS1-7190	2,4-Dimethylphenol	Continuing Calibration	20 R
TCLT-PV 23.8	Pentachlorophenol	Continuing Calibration	1.8 UG
TCLT-PV 25.3	Pentachlorophenol	Continuing Calibration	2.0 UG

Discussion: Numerous continuing calibration checks for analytes in several samples were out of criteria. Because the continuing calibration checks and the blank spike recoveries (discussed below) for acenaphthene associated with Samples TCLT-PV 19.0 and TCLT-PV 30.0 were low, these sample results were qualified "G" to indicate that the value is greater than shown. Because the continuing calibration checks and the blank spike recoveries (discussed below) for pentachlorophenol associated with Samples TCLT-PV 22.2, TCLT-PV 23.8, and TCLT-PV 25.3 and for benzyl alcohol for Sample DPC-BKS1-7190 were also low, these sample results were also qualified "G".

The continuing calibration check associated with 2,4-dimethylphenol on Sample DPC-BKS1-7190 was also low and the percent recoveries for the blank spike/blank spike duplicate were less than 10%, so this analyte was qualified "R" for unusable.

For all other results, no data qualifier flags are recommended because either the continuing calibration checks were high and the associated sample results were non-detect or the check meets the EPA Method 8000B acceptance criteria that an average of the continuing calibration checks be less than 20%.

4. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Discussion: Bis(2-ethylhexyl)phthalate was detected in the method blank analyzed with SDG 807014. The concentration of the compound was less than the reporting limit.

The laboratory has already flagged the samples appropriately with a "B" and no additional data qualifier flags are recommended.

5. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within QAPP or method criteria.

Discussion: Surrogates were out of criteria in the method blank associated with the acid fraction of SDGs 807014 and 807110, but no data qualifier flags are recommended because the surrogates in the samples were acceptable.

6. Matrix Spike/Matrix Spike Duplicate

Except as noted below, blank spikes (BS), blank spike duplicates (BSD), matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within QAPP or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 19.0	Acenaphthene	BS/BSD	4.3 G
TCLT-PV 22.2	Pentachlorophenol	BS/BSD	1.9 UG
TCLT-PV 6.0	Pentachlorophenol	BS/BSD	1.8 UG
TCLT-PV 30.0	Acenaphthene	BS/BSD	3.8 G
DPC-BKS1-7190	Benzyl alcohol	BS/BSD	2.1 G
DPC-BKS1-7190	2,4-Dimethylphenol	BS/BSD	20 R
TCLT-PV 23.8	Pentachlorophenol	BS/BSD	1.8 UG
TCLT-PV 25.3	Pentachlorophenol	BS/BSD	2.0 UG

Discussion: Acenaphthene was low and out of criteria for both accuracy (%R) and precision (RPD) for the BS/BSD pair associated with Samples TCLT-PV 19.0 and TCLT-PV 30.0. Because the continuing calibration was also low and out of criteria for these samples, these results were qualified "G" or "UG" to indicate a value or reporting limit that is greater than reported.

Pentachlorophenol was low and was low and out of criteria for accuracy for the BS/BSD pair associated with Samples TCLT-PV 6.0, TCLT-PV 22.2, TCLT-PV 23.8, and TCLT-PV 25.3. Because the continuing calibration was also low and

out of criteria, these values were qualified "UG" to indicate a reporting limit that is greater than reported.

Benzyl Alcohol was low and out of criteria for accuracy for the BS/BSD pair associated with Sample DPC-BKS1-7190. Because the continuing calibration was also low and out of criteria, this result was qualified "G" to indicate a value that is greater than reported.

The continuing calibration check associated with 2,4-Dimethylphenol on Sample DPC-BKS1-7190 was also low and the percent recoveries for the blank spike/blank spike duplicate were less than 10%, so this analyte was qualified "R" for unusable.

When reviewing the data, it appears as if a large number of analytes were out of criteria for blank spikes in several SDGs. However, except as noted in this narrative, none were target compounds.

7. Field Duplicates

No field duplicates were identified

8. Internal Standards Performance for Samples

Except as noted below, all internal standard areas were within the required control limits.

Discussion: In Sample Delivery Group 812013, the internal standard responses listed on Form VIII on Pages 9 and 10 differed from the raw data on Pages 72 and 73. In Sample Delivery Group 810020, the internal standard responses listed on Form VIII on Pages 6 and 7 differed from the raw data on Pages 55, 56, and 57. The limits were recalculated and in both cases, the associated samples were within the revised acceptance limits. No data qualifier flags are recommended.

Perylene-d_{12} (Internal Standard No. 6) in Samples DPC-BKS1-7190 and TCLT-PV 2.5 were low and out of criteria, but no data qualifier flags are recommended because no target analytes are associated with this internal standard.

9. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times, mass spectra, and peak identification of the referenced method.

10. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards, quantitation ion, and RRF. Reporting limits have been correctly adjusted for dilutions and extraction amounts, and meet the requirements of the contract.

11. Tentatively Identified Compounds (TICs)

No TICs were reported with this data set.

12. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing.

13. Laboratory Contact

The laboratory was contacted twice during the validation process. Kim Lofgren was telephoned and requested to replace illegible pages and to provide the missing continuing calibration check raw data. A copy of the confirming fax is attached to this report.

14. Other Comments

None.

15. Data Use and Overall Assessment

The analytes qualified with an "R" are unusable. All other data as qualified are acceptable for use. The analyses were generally within the requirements of the referenced method. No discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

E. Review of Pesticide Analyses by Gas Chromatography

EPA Method 8081A

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. Except as noted below, no data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 12.8	Heptachlor	Holding Time	0.057 UE
TCLT-PV 12.8	Dieldrin	Holding Time	0.11 UE
TCLT-PV 12.8	alpha-Chlordane	Holding Time	0.057 UE
TCLT-PV 12.8	gamma-Chlordane	Holding Time	0.057 UE
TCLT-PV 12.8	Hexachlorobutadiene	Holding Time	0.057 UE
TCLT-PV 15.8	Heptachlor	Holding Time	0.054 UE
TCLT-PV 15.8	Dieldrin	Holding Time	0.11 UE
TCLT-PV 15.8	alpha-Chlordane	Holding Time	0.054 UE
TCLT-PV 15.8	gamma-Chlordane	Holding Time	0.054 UE
TCLT-PV 15.8	Hexachlorobutadiene	Holding Time	0.054 UE
TCLT-PV 26.9	Heptachlor	Holding Time	0.10 UE
TCLT-PV 26.9	Dieldrin	Holding Time	0.10 UE
TCLT-PV 26.9	alpha-Chlordane	Holding Time	0.10 UE
TCLT-PV 26.9	gamma-Chlordane	Holding Time	0.10 UE
TCLT-PV 26.9	Hexachlorobutadiene	Holding Time	0.10 UE
TCLT-PV 25.3	Heptachlor	Holding Time	0.11 UE
TCLT-PV 25.3	Dieldrin	Holding Time	0.23 UE
TCLT-PV 25.3	alpha-Chlordane	Holding Time	0.11 UE
TCLT-PV 25.3	gamma-Chlordane	Holding Time	0.11 UE
TCLT-PV 25.3	Hexachlorobutadiene	Holding Time	0.11 UE
TCLT-PV 2.5	Heptachlor	Holding Time	0.054 UE
TCLT-PV 2.5	Dieldrin	Holding Time	0.11 UE
TCLT-PV 2.5	alpha-Chlordane	Holding Time	0.054 UE
TCLT-PV 2.5	gamma-Chlordane	Holding Time	0.054 UE
TCLT-PV 2.5	Hexachlorobutadiene	Holding Time	0.054 UE
DPC-METT-7298	Heptachlor	Holding Time	0.050 UE

Associated Samples	Analyte Affected	Type of Deviation	Flag
DPC-METT-7298	Dieldrin	Holding Time	0.10 UE
DPC-METT-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-METT-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-METT-7298	Hexachlorobutadiene	Holding Time	0.050 UE
DPC-METT-7298	Heptachlor	Holding Time	0.050 UE
DPC-METT-7298	Dieldrin	Holding Time	0.10 UE
DPC-METT-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-METT-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-METT-7298	Hexachlorobutadiene	Holding Time	0.050 UE
DPC-METD-7298	Heptachlor	Holding Time	0.050 UE
DPC-METD-7298	Dieldrin	Holding Time	0.10 UE
DPC-METD-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-METD-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-METD-7298	Hexachlorobutadiene	Holding Time	0.050 UE
DPC-DRET-7298	Heptachlor	Holding Time	0.050 UE
DPC-DRET-7298	Dieldrin	Holding Time	0.10 UE
DPC-DRET-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-DRET-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-DRET-7298	Hexachlorobutadiene	Holding Time	0.050 UE
DPC-WATT-7298	Heptachlor	Holding Time	0.050 UE
DPC-WATT-7298	Dieldrin	Holding Time	0.10 UE
DPC-WATT-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-WATT-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-WATT-7298	Hexachlorobutadiene	Holding Time	0.050 UE
DPC-WATD-7298	Heptachlor	Holding Time	0.050 UE
DPC-WATD-7298	Dieldrin	Holding Time	0.10 UE
DPC-WATD-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-WATD-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-WATD-7298	Hexachlorobutadiene	Holding Time	0.050 UE
DPC-Duplicate-7298	Heptachlor	Holding Time	0.050 UE
DPC-Duplicate-7298	Dieldrin	Holding Time	0.10 UE
DPC-Duplicate-7298	alpha-Chlordane	Holding Time	0.050 UE
DPC-Duplicate-7298	gamma-Chlordane	Holding Time	0.050 UE
DPC-Duplicate-7298	Hexachlorobutadiene	Holding Time	0.050 UE

Discussion: The temperature upon receipt by the laboratory for four coolers was ranged from 7.5 °C to 12 °C, which is above the criteria of 6 ± 2 °C. These coolers contained Samples TCLT-PV 7.3, TCLT-Rinsate 1L, TCLT-PV 12.8 and TCLT-PV 9.0,

and showed evidence of cooling. Because these analyses are not highly volatile, it is the judgment of the reviewer that the impact of this exceedence does not warrant a data qualifier flag.

The analysis of several samples, listed in the table above, exceeded the holding time by times ranging from one to twenty days. All results were non-detect and are qualified "UE" for estimated.

Sample TCLT-PV 23.8 was analyzed within the holding time but was analyzed by the CLP pesticide/PCB method. It was reanalyzed five days past the holding time by EPA 8081. The laboratory reported all analytes except Hexachlorobutadiene from the CLP analysis, and Hexachlorobutadiene was reported from the EPA 8081 analysis. All results were non-detect. A review of the chromatograms from the earlier analysis indicates that Hexachlorobutadiene was non-detect, and no data qualifier flag is recommended for this analyte.

2. Initial and Continuing Calibration

Except as noted below, all initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 25.3	Hexachlorobutadiene	Continuing Calibration	0.11 UE
TCLT-PV 30.0	Hexachlorobutadiene	Continuing Calibration	0.10 UE

Discussion: Numerous continuing calibration checks for analytes and surrogates in several samples were out of criteria. Samples TCLT-PV 25.3 and TCLT-PV 30.0 were associated with continuing calibration checks that were low and these samples were qualified "UE" for estimated. For all other results, no data qualifier flags are recommended because the continuing calibration checks were high and the associated sample results were non-detect.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Except as noted below, surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within QAPP or method criteria.

Discussion: The percent recoveries for the surrogate Decachlorobiphenyl for the method blanks associated with Samples TCLT-PV 12.8, TCLT-PV 14.4, TCLT-PV 19.0, and TCLT-PV 30.0, and for the blank spike/blank spike duplicate associated with Samples TCLT-PV 12.8, TCLT-PV 14.4, and TCLT-PV 22.2, were out of criteria. However, no data qualifier flags are recommended because the standards are QC checks and all surrogates of the samples are acceptable.

The percent recoveries for the surrogate Decachlorobiphenyl was out of criteria in Samples TCLT-PV 20.6, TCLT-PV 22.2, TCLT-PV 23.8, and TCLT-PV 28.4, but no data qualifier flags are recommended because the other surrogate (TCMX) was within criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were not analyzed with these sets of analyses. The laboratory analyzed a blank spike (BS) and blank spike duplicate (BSD) to measure precision and accuracy. All percent recoveries (%Rec) and relative percent differences (RPD) were within QAPP or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 20.6	Hexachlorobutadiene	BS/BSD	0.052 UE
TCLT-PV 22.2	Hexachlorobutadiene	BS/BSD	0.054 UE

Discussion: Dieldrin and/or Heptachlor was high and out of criteria for accuracy (%R) for the BS/BSD pair associated with Samples TCLT-PV 12.8, TCLT-PV 14.4, and TCLT-PV 28.4. No data qualifier flags are recommended because the %R was high and the associated sample results were non-detect.

Hexachlorobutadiene was low and out of criteria for the BS/BSD pair associated with Samples TCLT-PV 20.6 and 22.2. These samples have been qualified "UE" for estimated.

Hexachlorobutadiene was out of criteria for the BS associated with Sample TCLT-PV 25.3, but no data qualifier flags are recommended because the BSD was acceptable.

6. Field Duplicates

No field duplicates were identified.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts, and meet requirements of the contract.

Discussion: The results for Heptachlor and Hexachlorobutadiene for the BS/BSD associated with several samples were qualitatively confirmed on the second column. However, there was greater than 20% difference in the quantitation between the two columns and the laboratory has appropriately qualified these results with "P" and has reported the higher values. No data qualifier flags are recommended for the sample results because all results were non-detect and the reported values were within the BS/BSD percent recovery criteria.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, peak tailing, or DDT/Endrin breakdown for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data, as qualified, are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

F. Review of PCB Analyses by Gas Chromatography

EPA Method 8082

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration QC criteria were met. No Target Compound List (TCL) analytes had Percent Relative Standard Deviations (%RDS) greater than that allowed by the method.

Discussion: A calibration check for the surrogate Decachlorobiphenyl, which was associated with Sample DPC-BKS1-7198, was out of criteria. No data qualifier flags are recommended because the other surrogate in both the sample and the continuing calibration check were acceptable.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Surrogate Recovery

Surrogate analytes were added to all samples and blanks as required by the referenced method and all recoveries were within QAPP or method criteria.

5. Matrix Spike/Matrix Spike Duplicate

Matrix spikes (MS) and matrix spike duplicates (MSD) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within QAPP or method criteria.

6. Field Duplicates

No field duplicates were identified.

7. TCL Compound Identification

All TCL Compound identifications met the criteria for retention times and peak identification of the referenced material.

8. Compound Quantitation and Reported Detection Limits

Quantitation was performed in accordance with the referenced method, including the correct calculations using appropriate internal standards or external standardization. Reporting limits have been correctly adjusted for dilutions and extraction amounts, and meet the requirements of the contract.

9. System Performance

The system performance was acceptable and had no significant problems such as baseline shifts, loss of resolution, or peak tailing for the initial calibration and all dates of analysis.

10. Laboratory Contact

There was no verbal or written communication with the laboratory.

11. Other Comments

None.

12. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

G. Review of Metal Analyses

EPA Method 6010 and 7000 Series

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

Discussion: EPA Method 6010 requires the analysis of a low level check standard to demonstrate that the reporting limit may be obtained, but the method has no acceptance criteria established. The laboratory had established an arbitrary limit of 50% - 150% and, in the analysis of SDGs 807099 and 807073, the result for Cadmium was low and out of criteria. The value for Nickel was low but within criteria. No data qualifier flags are recommended because there is no method or QAPP criteria established for this QC check, and because the results demonstrate that the reporting may be obtained.

3. Blanks and Checks for Contamination

Except as noted below, instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 11.5	Zinc	Blank Contamination	48.2 B
TCLT-PV 24.3	Lead	Blank Contamination	70.8 B
TCLT-PV 22.9	Lead	Blank Contamination	69.4 B
TCLT-PV 21.2	Lead	Blank Contamination	87.6 B

Discussion: Zinc was noted in the method blank associated with Sample TCLT-PV 11.5 and this result was qualified "B" to indicate blank contamination.

Lead was noted in the method blank associated with Samples TCLT-PV 22.9, TCLT-PV 21.2, and TCLT-PV 24.3 and these results were qualified "B" to indicate blank contamination.

Sample TCLT-PV 25.9 was associated with a method blank that had trace contamination of lead, but the sample value was greater than ten times the blank. Similarly, Sample DPC-BKS1-7/1/98 was associated with a method blank that had trace contamination of Zinc. PSEP validation guidance does not discuss the "five-times" and "ten-times" rules that are recommended in Functional Guidelines, but instead recommends qualifying samples associated with blank contamination with a "B" flag. However, the reviewer concurs with the laboratory's case narrative, which stated that "B" qualifier flags should not be applied to values that are greater than ten times the blank contamination, and no data qualifier flags are recommended.

4. ICP Interference Check Standard

Except as noted below, the Interference Check Sample was analyzed at a frequency required by the referenced method and was within established criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 24.3	Nickel	Interference Check	7.0 E
TCLT-PV 22.9	Nickel	Interference Check	5.3 E
TCLT-PV 21.2	Nickel	Interference Check	9.8 E

Discussion: Nickel was out of criteria in the Interference Check Sample associated with Samples TCLT-PV 22.9, TCLT-PV 21.2, and TCLT-PV 24.3. This analyte was qualified "E" for estimated.

5. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within QAPP or method criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 6.2	Arsenic	LCS	5.0 UG
TCLT-PV 5.0	Arsenic	LCS	5.0 UG

Discussion: Arsenic was out of criteria for accuracy (percent recovery) on the Laboratory Control Standard (LCS) associated with Sample TCLT-PV 6.2 and TCLT-PV 5.0. Because the LCS was low, the Arsenic value is qualified "G" to indicate a reporting limit that is greater than reported.

The laboratory noted in their case narrative that Chromium, Nickel, and Zinc in Samples DPC-METT-7/2/98 through DPC-Duplicate-7, TCLT-PV1 5.0, and TCLT Rinsate had been reported from a second preparation and analysis because the blank spike from the first analysis was out of the acceptance criteria. The reviewer concurs that the corrective action was appropriate.

6. Matrix Spike/Duplicate

Except as noted below, matrix spikes (MS) and duplicates (Dup) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within QAPP criteria.

Associated Samples	Analyte Affected	Type of Deviation	Flag
TCLT-PV 18.0	Copper	Matrix Spike	98.9 G
TCLT-PV 18.0	Lead	Duplicate	86.0 E
TCLT-PV 21.2	Cadmium	Matrix Spike	0.60 E
DPC-BKS1-7/1/98	Antimony	Matrix Spike	3.9 UG
DPC-BKS1-7/1/98	Zinc	Matrix Spike	108 G
DPC-BKS1-7/1/98	Arsenic	Duplicate	13.2 E
DPC-BKS1-7/1/98	Mercury	Duplicate	1.1 E

Discussion: EPA Method 6010 requires the analysis of matrix spikes and matrix spike duplicates. Although the laboratory referenced EPA Method 6010 for this analysis, the samples were analyzed in accordance with PSEP guidelines, in which a single matrix spike and a sample duplicate are analyzed as QC checks. No data qualifier flags are recommended.

Lead and Copper were out of criteria for accuracy (%Rec) and precision (RPD), respectively, on the matrix spike and duplicate analysis of Sample TCLT-PV

18.0. Because the matrix spike was low, the Copper value is qualified "G" to indicate a value that is greater than reported. The Lead value is qualified "E" for estimated.

Antimony and Zinc were out of criteria for accuracy (%Rec) on the matrix spike of Sample DPC-BKS1-7/1/98. Because the matrix spike recoveries were low, these values are qualified "G" to indicate a value or a reporting limit that is greater than reported.

Arsenic and Mercury were out of criteria for precision (RPD) on the duplicate analysis of Sample DPC-BKS1-7/1/98. These values are qualified "E" for estimated.

Cadmium was out of criteria for accuracy (%Rec) on the matrix spike analysis of Sample TCLT-PV 21.2. Even though the matrix spike was high, the Cadmium value is qualified "E" for estimated because the %Rec was only 1% out of criteria.

The laboratory noted in their case narrative that Cadmium in Samples DPC-METT-7/2/98 through DPC-Duplicate-7, TCLT-PV1-5, and TCLT Rinsate had been reported from a second preparation and analysis because the blank spike from the first analysis was out of criteria. The reviewer concurs that the corrective action was appropriate.

The following analytes were out of the acceptance criteria for accuracy (%Rec) due to high concentrations of these analytes in the original sample. Since all other QC checks were in criteria, no data qualifier flags are recommended.

Analyte Affected	Associated Samples
Cadmium, Copper	TCLT-PV 11.5
Copper	TCLT-PV 16.5
Copper	TCLT-PV 19.6
Copper	TCLT-PV 13.4
Lead	TCLT-PV 24.3
Copper	TCLT-PV 80
Copper	TCLT-PV 10
Lead	TCLT-PV 21.2
Copper	TCLT-PV 14.9
Copper	TCLT-PV 25.9

Nickel in Sample TCLT-PV 19.6, Lead in Sample TCLT-PV 10, and Zinc in Samples TCLT-PV 6.3 and TCLT-PV 5.0 were out of the acceptance criteria for precision (RPD) in the laboratory duplicate. Replicate values that are close to the reporting limit are expected to have a greater variation than values that are higher in the instrument's analytical range. Because the reported values were within a factor of five of the reporting limit, no data qualifier flags are recommended.

Nickel in Samples TCLT-PV 30.0, TCLT-PV 6.3, and TCLT-PV 5.0, and Chromium in Samples TCLT-PV 8.0 and TCLT-PV 10 appeared to be out of the acceptance criteria for precision (RPD) in the laboratory duplicate. However, the actual results were non-detect in the sample and a trace hit near the detection limit in the duplicate. The forms printing software incorrectly calculated the RPD as being high, whereas the values actually were similar. No data qualifier flags are recommended.

7. Graphite Furnace Atomic Absorption Analysis

All special criteria for GFAA analysis were performed at the frequency required by the referenced method and were within established criteria.

8. ICP Serial Dilution

Samples that were a factor of 50 above the Instrument Detection Limit for the analyte were diluted 5-fold and were within criteria required by the referenced method.

9. Field Duplicates

No field duplicates were identified.

10. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. No errors in accuracy were found. Reporting limits meet the requirements of the contract.

Discussion: The reporting limit for Cadmium for Sample TCLT-PV 14.9 was doubled because the laboratory redigested the sample after observing suspected contamination. The laboratory did not have enough sample for a full volume digestion and used half of the normal volume. The reviewer concurs that this corrective action was appropriate.

11. Laboratory Contact

There was no verbal or written communication with the laboratory.

12. Other Comments

None.

13. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results. All data flags are summarized at the end of this report.

H. Review of Inorganic Analyses

Percent Moisture, Ammonia, Sulfide, and TOC

1. Timeliness and a Check for Errors

The analytical plan and the data packages were reviewed and compared against the chain-of-custody and other data. No data are missing from the packages and no errors in accuracy were found. All tests requested on the chain-of-custody were performed. All samples were analyzed within the technical holding times. There are no contractual holding time criteria that have been brought to the attention of the reviewer.

2. Initial and Continuing Calibration

All initial and continuing calibration Quality Control criteria were met, including the number of standards used and correlation coefficients. All continuing calibration criteria, including frequency of analysis and percent recovery were met.

3. Blanks and Checks for Contamination

Instrument and method blank analyses were performed at the required frequencies and either no analytes were detected or levels were below the reporting limit.

4. Laboratory Control Standards

A Laboratory Control Standard was analyzed at a frequency required by the referenced method and all percent recoveries were within QAPP or method criteria.

5. Precision and Accuracy

Matrix spikes (MS) and sample duplicates (Dup) were analyzed as required by the referenced method and all percent recoveries (%Rec) and relative percent differences (RPD) were within QAPP or method criteria.

6. Field Duplicates

No field duplicates were identified

7. Sample Result Verification

The final reports were reviewed and compared against raw instrumental data and logs to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions. Reporting limits meet the requirements of the contract. Except as notes below, no errors in accuracy were found.

8. Laboratory Contact

There was no verbal or written communication with the laboratory.

9. Other Comments

None.

10. Data Use and Overall Assessment

The data are acceptable for use. The analyses were generally within the requirements of the referenced method and no discrepancies were observed between raw data and reported data results.

Attachment 1
Puget Sound Estuary Program Data Qualifier Definitions

Quality By Design

Puget Sound Estuary Program Data Qualifier Definitions

Used for both organics and inorganic analyses

B = Analyte detected in samples and in method blank

C = Combined with unresolved substances

E = Estimated

G = Value greater than minimum shown

K = Detected at less than the maximum shown

L = Value less than the maximum shown

M = Value is a mean

Q = Questionable value

R = Rejected or unusable value

T = Detected below the quantification limit shown

U = Undetected at the detection limit shown

Z = Blank corrected

Attachment 2
Data Qualification Summary

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
	DPC-METT-7298	807014-1	8081	92	Heptachlor	0.050	UE	Holding Time
	DPC-METT-7298	807014-1	8081	91	Dieldrin	0.10	UE	Holding Time
	DPC-METT-7298	807014-1	8081	90	alpha-Chlordane	0.050	UE	Holding Time
	DPC-METT-7298	807014-1	8081	139	gamma-Chlordane	0.050	UE	Holding Time
	DPC-METT-7298	807014-1	8081	36	Hexachlorobutadiene	0.050	UE	Holding Time
	DPC-METD-7298	807014-2	8081	92	Heptachlor	0.050	UE	Holding Time
	DPC-METD-7298	807014-2	8081	91	Dieldrin	0.10	UE	Holding Time
	DPC-METD-7298	807014-2	8081	90	alpha-Chlordane	0.050	UE	Holding Time
	DPC-METD-7298	807014-2	8081	139	gamma-Chlordane	0.050	UE	Holding Time
	DPC-METD-7298	807014-2	8081	36	Hexachlorobutadiene	0.050	UE	Holding Time
	DPC-DRET-7298	807014-3	8081	92	Heptachlor	0.050	UE	Holding Time
	DPC-DRET-7298	807014-3	8081	91	Dieldrin	0.10	UE	Holding Time
	DPC-DRET-7298	807014-3	8081	90	alpha-Chlordane	0.050	UE	Holding Time
	DPC-DRET-7298	807014-3	8081	139	gamma-Chlordane	0.050	UE	Holding Time
	DPC-DRET-7298	807014-3	8081	36	Hexachlorobutadiene	0.050	UE	Holding Time
	DPC-WATT-7298	807014-4	8081	92	Heptachlor	0.050	UE	Holding Time
	DPC-WATT-7298	807014-4	8081	91	Dieldrin	0.10	UE	Holding Time
	DPC-WATT-7298	807014-4	8081	90	alpha-Chlordane	0.050	UE	Holding Time
	DPC-WATT-7298	807014-4	8081	139	gamma-Chlordane	0.050	UE	Holding Time
	DPC-WATT-7298	807014-4	8081	36	Hexachlorobutadiene	0.050	UE	Holding Time
	DPC-WATD-7298	807014-5	8081	92	Heptachlor	0.050	UE	Holding Time
	DPC-WATD-7298	807014-5	8081	91	Dieldrin	0.10	UE	Holding Time
	DPC-WATD-7298	807014-5	8081	90	alpha-Chlordane	0.050	UE	Holding Time
	DPC-WATD-7298	807014-5	8081	139	gamma-Chlordane	0.050	UE	Holding Time
	DPC-WATD-7298	807014-5	8081	36	Hexachlorobutadiene	0.050	UE	Holding Time
	DPC-Duplicate-7298	807014-6	8081	92	Heptachlor	0.050	UE	Holding Time
	DPC-Duplicate-7298	807014-6	8081	91	Dieldrin	0.10	UE	Holding Time
	DPC-Duplicate-7298	807014-6	8081	90	alpha-Chlordane	0.050	UE	Holding Time
	DPC-Duplicate-7298	807014-6	8081	139	gamma-Chlordane	0.050	UE	Holding Time
	DPC-Duplicate-7298	807014-6	8081	36	Hexachlorobutadiene	0.050	UE	Holding Time
	DPC-BKS1-7190	807014-7	8270	7	Benzyl alcohol	2.1	G	Continuing Calibration, BS/BSD
	DPC-BKS1-7190	807014-7	8270	68	2,4-Dimethylphenol	20	R	Continuing Calibration, BS/BSD
	DPC-BKS1-7/1/98	807014-7	6010	54	Antimony	3.9	UG	Matrix Spike
	DPC-BKS1-7/1/98	807014-7	6010	62	Zinc	108	G	Matrix Spike
	DPC-BKS1-7/1/98	807014-7	7060	55	Arsenic	13.2	E	Duplicate
	DPC-BKS1-7/1/98	807014-7	7470	59	Mercury	1.1	E	Duplicate
	TCLT-PV 2.5	807030-2	8081	92	Heptachlor	0.054	UE	Holding Time
	TCLT-PV 2.5	807030-2	8081	91	Dieldrin	0.11	UE	Holding Time
	TCLT-PV 2.5	807030-2	8081	90	alpha-Chlordane	0.054	UE	Holding Time
	TCLT-PV 2.5	807030-2	8081	139	gamma-Chlordane	0.054	UE	Holding Time
	TCLT-PV 2.5	807030-2	8081	36	Hexachlorobutadiene	0.054	UE	Holding Time
	TCLT-PV 6.0	807093-1	8270	74	Pentachlorophenol	1.8	G	BS/BSD
	TCLT-PV 5.0	807073-1	7060	55	Arsenic	5	UG	LCS
	TCLT-PV 6.3	807099-1	7060	55	Arsenic	5	UG	LCS
	TCLT-PV 11.5	808067-1	6010	62	Zinc	48.2	B	Blank Contamination
	TCLT-PV 12.8	809004-1	8081	92	Heptachlor	0.057	UE	Holding Time
	TCLT-PV 12.8	809004-1	8081	91	Dieldrin	0.11	UE	Holding Time
	TCLT-PV 12.8	809004-1	8081	90	alpha-Chlordane	0.057	UE	Holding Time

Data Qualification Summary

FW Sample #	Sample ID	Assession Number	Method	FW Parameter #	Target Analyte	Value	Flag	Reason
	TCLT-PV 12.8	809004-1	8081	139	gamma-Chlordane	0.057	UE	Holding Time
	TCLT-PV 12.8	809004-1	8081	36	Hexachlorobutadiene	0.057	UE	Holding Time
	TCLT-PV 15.8	809060-1	8081	92	Heptachlor	0.054	UE	Holding Time
	TCLT-PV 15.8	809060-1	8081	91	Dieldrin	0.11	UE	Holding Time
	TCLT-PV 15.8	809060-1	8081	90	alpha-Chlordane	0.054	UE	Holding Time
	TCLT-PV 15.8	809060-1	8081	139	gamma-Chlordane	0.054	UE	Holding Time
	TCLT-PV 15.8	809060-1	8081	36	Hexachlorobutadiene	0.054	UE	Holding Time
	TCLT-PV 18.0	810003-1	6010	57	Copper	98.9	G	Matrix Spike
	TCLT-PV 18.0	810003-1	7421	58	Lead	86	E	Duplicate
	TCLT-PV 19.0	810020-1	8270	74	Acenaphthene	4.3	G	Continuing Calibration, BS/BSD
	TCLT-PV 20.6	810054-1	8081	36	Hexachlorobutadiene	0.052	UE	BS/BSD
	TCLT-PV 21.2	810054-2	7421	58	Lead	87.6	B	Blank Contamination
	TCLT-PV 21.2	810054-2	6010	60	Nickel	9.8	E	Interference Check
	TCLT-PV 21.2	810054-2	7131	56	Cadmium	0.60	E	Matrix Spike
	TCLT-PV 22.2	810089-1	8270	22	Pentachlorophenol	1.9	UG	Continuing Calibration, BS/BSD
	TCLT-PV 22.2	810089-1	8081	36	Hexachlorobutadiene	0.054	UE	BS/BSD
	TCLT-PV 22.9	810096-1	7421	58	Lead	69.4	B	Blank Contamination
	TCLT-PV 22.9	810096-1	6010	60	Nickel	5.3	E	Interference Check
	TCLT-PV 23.8	811011-1	8270	22	Pentachlorophenol	1.8	UG	Continuing Calibration, BS/BSD
	TCLT-PV 24.3	811023-1	7421	58	Lead	70.8	B	Blank Contamination
	TCLT-PV 24.3	811023-1	6010	60	Nickel	7.0	E	Interference Check
	TCLT-PV 25.3	811034-1	8270	22	Pentachlorophenol	2.0	UG	Continuing Calibration, BS/BSD
	TCLT-PV 25.3	811034-1	8081	92	Heptachlor	0.11	UE	Holding Time
	TCLT-PV 25.3	811034-1	8081	91	Dieldrin	0.23	UE	Holding Time
	TCLT-PV 25.3	811034-1	8081	90	alpha-Chlordane	0.11	UE	Holding Time
	TCLT-PV 25.3	811034-1	8081	139	gamma-Chlordane	0.11	UE	Holding Time
	TCLT-PV 25.3	811034-1	8081	36	Hexachlorobutadiene	0.11	UE	Continuing Calibration, Holding Time
	TCLT-PV 26.9	811066-1	8081	92	Heptachlor	0.10	UE	Holding Time
	TCLT-PV 26.9	811066-1	8081	91	Dieldrin	0.10	UE	Holding Time
	TCLT-PV 26.9	811066-1	8081	90	alpha-Chlordane	0.10	UE	Holding Time
	TCLT-PV 26.9	811066-1	8081	139	gamma-Chlordane	0.10	UE	Holding Time
	TCLT-PV 26.9	811066-1	8081	36	Hexachlorobutadiene	0.10	UE	Holding Time
	TCLT-PV 30.0	812013-1	8270	74	Acenaphthene	3.8	G	Continuing Calibration, BS/BSD
	TCLT-PV 30.0	812013-1	8081	36	Hexachlorobutadiene	0.10	UE	Continuing Calibration

Attachment 3
Data Evaluation Summary

DATA ASSESSMENT SUMMARY

Case/SAS No.: Middle Waterway

Laboratory: MultiChem Analytical Service

SDG No.: Summary of All SDGs

Data Use: Foster Wheeler Environmental Corp.

Method: PSEP

Review Completion Data: April 26, 1999

No. of Samples: 20

Reviewer: Quality by Design

QC ITEM	VOA	BNA	Pest	PCB	Metals	Inorg
Holding Times	O	O	M	O	O	O
GC/MS Performance	O	O	O	O	O	O
Initial & Continuing Calibration	O	X	X	O	O	O
Field Blanks (F=N/A)	F	F	F	F	F	F
Laboratory Blanks	O	O	O	O	X	O
Surrogates	O	O	O	O	O	O
Matrix Spikes/Duplicates	O	X	X	O	M	O
QC Samples (LCS, PVS)	O	O	O	O	O	O
Internal Standards	O	O	O	O	O	O
Compound Identification	O	O	O	O	O	O
Compound Quantification	O	O	O	O	O	O
System Performance	O	O	O	O	X	O
Overall Assessment	O	X	M	O	M	O

O = No problems or minor problems that do not affect data usability.
X = No more than about 5% of the data points are qualified as either estimated or unusable.
M = More than about 5% of the data points are qualified as either estimated or unusable.
Z = More than about 5% of the data points are qualified as unusable.

Areas of Concern: Most data qualifiers involved holding time issues in pesticide analysis and spike failures in metals, pesticides, and BNAs. Less than 1% overall involved continuing calibration issues and blank contamination.

DATA EVALUATION SUMMARY

Summary of All Sample Delivery Groups

Date: April 26, 1999

Site Name: Middle Waterway

Lab Name: MultiChem Analytical

Type of Review: PSEP

Number of Samples: 20

Analytes Estimated Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD, BS/BSD	Internal Standard	Other	Total # of Analytes	.Total # Estimated/Total # in all Samples
VOA								0	0/8 = 0 %
SVOA			7		8			8	8/120 = 6.7 %
PEST		55	1		2			58	58/100 = 58 %
PCB								0	0/7 = 0 %
METALS				4	9		3	16	16/180 = 9.7 %
INORG								0	0/10 = 0 %

Analytes Rejected Due to Exceeding Review Criteria For:

	Surrogates	Holding Time	Calibration	Contamination	MS/MSD, BS/BSD	Internal Standard	Other	Total # of Analytes	Total # Rejected/Total # in all Samples
VOA								0	0/8 = 0 %
SVOA			1		1			1	1/120 = 0.8 %
PEST								0	0/100 = 0 %
PCB								0	0/7 = 0 %
METALS								0	0/180 = 0 %
INORG								0	0/10 = 0 %

Attachment 4
Communications with the Laboratory

Post-It® Fax Note 7671	Date 3/22	# of pages ▸ 4
To Gary Braun	From T. Davis	
Co./Dept. Foster Wheeler	Co. QBD	
Phone #	Phone #	
Fax # 425/688-3951	Fax #	

Quality by Design
97 Puhili Street
Hilo, Hawaii 96720
Phone: 808/969-9424 Fax: 808/969-9094
e-mail: qbdhilo@gte.net

Date: March 22, 1999
To: MultiChem Analytical Services
Attn: Kim Lofgren

Fax #: 425/228-8336
From: Tom Davis
Total pages,
including this one: 4

Confirming our telephone discussion, we are performing a data validation on the Middle Waterway data that was provided by MultiChem to Foster Wheeler. If there are any questions regarding our relationship with Foster Wheeler, please contact Gary Braun at 425/688-3840.

Could you please help us out with two issues:

1. Some of the semivolatile chromatograms and quantitation reports are faint and illegible. For Method 8270, could we obtain copies for SDG 807014 for Pages 11-38 for the leachate and for Pages 8-16 in the acid fraction? Allison Avery, of Foster Wheeler, does not have legible copies either.

2. In the following SDGs, the continuing calibration had one or more target analytes for which the %Diff was out of criteria. The data package notes that the continuing calibration was accepted because the average of all compounds was acceptable. However, depending upon your interpretation, we have one of two problems:

A. As we read Method 8000B, Section 7.7, Paragraph 6, the %Diff for all compounds needs to be averaged (Section 7.5.1.2.2) and reported in a summary (Section 7.5.1.2.3). However, our data packages do not have data for all of the other non-reported analytes to verify this.

B. If only the six target compounds were checked, then at least one of the SDGs has an average %Diff that is greater than 15 and the continuing calibration check failed its criteria.

I am attaching excerpts from Method 8000B for reference.

Could you please clarify the continuing calibrations for these SDGs:

811066
812003
812013 (1/6/99 only)
807014 (acid fraction on 7/24 on HP-3, BN fraction on 7/24 and 7/278 on HP-1)
811011

810089
810054
810020
809077
809060

Thank you for your assistance. Please feel free to call if there are any questions or other issues.

cc: Debbie Copsey, QBD (via e-mail)
Gary Braun, Foster Wheeler

Send Hard Copy? ___ Yes _XX_ No

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In keeping with the approach described for initial calibration in Sec 7.5, if the average of the responses for all analytes is within 15%, then the calibration has been verified. However, the conditions in Sec. 7.5.1.2 also apply, e.g., the average must include all analytes in the calibration, regardless of whether they are target analytes for a specific project, and the data user must be provided with the calibration verification data or a list of those analytes that exceeded the 15% limit. The effect of using the average of the response for all analytes for calibration verification will be similar to that for the initial calibration – namely, that the quantitative results for those analytes where the difference is greater than 15% will include a greater uncertainty. The analyst and the data user should review the note in Sec. 7.5.1.2.

Sec 7.7 P6

If the calibration does not meet the 15% limit (either on the basis of each compound or the average across all compounds), check the instrument operating conditions, and if necessary, restore them to the original settings, and inject another aliquot of the calibration verification standard. If the response for the analyte is still not within ±15%, then a new initial calibration must be prepared.

7.7.1 Verification of linear calibrations

Calibration verification for linear calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. Use the equations below to calculate % Drift or % Difference, depending on the procedure specified in the determinative method.

$$\% \text{ Drift} = \frac{\text{Calculated concentration} - \text{Theoretical concentration}}{\text{Theoretical concentration}} \times 100$$

where the calculated concentration is determined using the mean calibration factor or response factor from the initial calibration and the theoretical concentration is the concentration at which the standard was prepared.

$$\% \text{ Difference} = \frac{CF_v - \overline{CF}}{\overline{CF}} \times 100 \qquad \text{or} \qquad = \frac{RF_v - \overline{RF}}{\overline{RF}} \times 100$$

where CF_v and RF_v are the calibration factor and the response factor (whichever applies) from the analysis of the verification standard, and $\overline{CF}$ and $\overline{RF}$ are the mean calibration factor and mean response factor from the initial calibration. Except where superseded in certain determinative methods, the % difference or % drift calculated for the calibration verification standard must be within ±15% for each analyte, or averaged across all analytes (see Sec 7.7), before any sample analyses may take place.

7.7.2 Verification of a non-linear calibration

Calibration verification of a non-linear calibration is performed using the percent drift calculation described in Sec. 7.7.1, above. Except where superseded in certain determinative methods, the % drift calculated for the calibration verification standard must be within ±15% for each analyte, or averaged across all analytes (see Sec 7.7), before any sample analyses may take place. It may also be appropriate to employ two standards at different concentrations to verify the calibration. In this instance, one standard should be near the inflection point in the curve. The choice of specific standards and concentrations is generally a method- or project-specific consideration.

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7.5.1.2.1 The mean of the RSD values for all analytes in the calibration is less than or equal to 20%. The mean RSD is calculated by summing the RSD value for each analyte and dividing by the total number of analytes. If no analyte has an RSD above 20%, then the mean RSD calculation need not be performed.

7.5.1.2.2 The mean RSD criterion applies to all analytes in the standards, regardless of whether or not they are of interest for a specific project. In other words, if the target analyte is part of the calibration standard, its RSD value is included in the evaluation.

7.5.1.2.3 The data user must be provided with either a summary of the initial calibration data or a specific list of those compounds for which the RSD exceeded 20% and the results of the mean RSD calculation.

NOTE: The analyst and the data user must be aware that the use of the approach listed in Sec. 7.5.1.2.1 (i.e., the average of all RSD values ≤ 20%) will lead to greater uncertainty for those analytes for which the RSD is greater than 20%. The analyst and the data user should review the associated quality control results carefully, with particular attention to the matrix spike and laboratory control sample results (see Sec. 8.0), to determine if the calibration linearity poses a significant concern. If this approach is not acceptable for a particular application, then the analyst may need to employ one of the other calibration approaches (see Secs. 7.5.2 to 7.5.4) or adjust the instrument operating conditions and/or the calibration range until the RSD is ≤ 20%.

7.5.1.3 If all of the conditions in Sec. 7.5.1.2 are met, then the average calibration or response factor may be used to determine sample concentrations, as described in Sec. 7.10.

7.5.2 Linear calibration using a least squares regression

If the RSD of the calibration or response factors is greater than 20% over the calibration range, then linearity through the origin cannot be assumed. If this is the case, the analyst may employ a regression equation that does not pass through the origin. This approach may also be employed based on past experience or *a priori* knowledge of the instrument response. Further, at the discretion of the analyst, this approach also may be used for analytes that do meet the RSD limits in Sec. 7.5.1.

This is most easily achieved by performing a linear regression of the instrument response versus the concentration of the standards. Make certain that the instrument response is treated as the dependent variable (y) and the concentration as the independent variable (x). This is a statistical requirement and is not simply a graphical convention.

The analyst may also employ a weighted least squares regression if replicate multi-point calibrations have been performed, e.g., three 5-point curves. For all other instances, an appropriate unweighted least squares method should be used. When using a weighted linear least squares regression, the following weighting factor should be used:

$$\frac{1}{SD^2}$$

APPENDIX F

APPENDIX F

CONTAMINANT MOBILITY RESULTS

FINAL REPORT
for the
MIDDLE WATERWAY
CONTAMINANT MOBILITY TESTING

June 1999

Prepared for:

Foster Wheeler
10900 NE 8th St.
Bellevue, WA 98004

Prepared by:

Soil Technology, Inc.
7865 NE Day Rd. W
Bainbridge Island, WA 98110

1.0 Introduction

This report summarizes results from contaminant mobility testing completed by Soil Technology, Inc. (STI) in fulfillment of the tests identified in the PRD/RD Work Plan for the Middle Waterway Problem Area. The work was performed in accordance with the Work Plan and verbal technical modifications agreed upon by Foster Wheeler and STI personnel.

2.0 Sample Handling

All samples sent to Soil Technology, Inc. for this project arrived at the laboratory under chain of custody (COC). Each core sample was inspected to ensure that no evidence of pore leakage occurred during transport. The sample custodian logged each sample into the laboratory sample tracking system, signed the chain of custody, and placed samples in cold storage until needed for analysis. All leachate samples sent from Soil Technology, Inc. to the designated analytical laboratory were also accompanied by a chain of custody. Samples for chemical analysis were shipped to MultiChem Analytical Services in Renton, WA.

The general decontamination procedure for equipment used during contaminant mobility testing was as follows:

1. Liquinox and water wash
2. Tap water rinse
3. 10% HNO_3 rinse
4. Tap water rinse
5. 10% HCl rinse
6. Tap water rinse
7. Methanol rinse
8. 2X reagent water rinse

3.0 Anaerobic Core Extrusion and Compositing

All extruding and compositing of sediment cores was done under an anaerobic (nitrogen) atmosphere. Sediment was extruded from cores into stainless steel containers by a combination of vibrational and gravitational forces. Sediment was thoroughly mixed, dispensed into glass jars and held at 4°C until needed for compositing. The core identifications and extrusion dates are shown in Table 1.

The dredge prism composite sample was made following instructions provided by Foster Wheeler. The volumes of sediment used from each core to make the dredge prism composite are shown in Table 1. One composite sample comprising 16 liters was prepared under an anaerobic environment on June 19, 1998 for use in the elutriate tests and the thin layer column leaching test. A second composite sample to use for the column settling test was prepared aerobically using the same volumes of sediment as the first composite to comprise 16 liters on July 7, 1998. The dredge prism composite samples were prepared by thoroughly mixing appropriate volumes of core samples together in stainless steel containers, dispensing into glass jars and holding at 4°C until needed.

Table 1: Sediment Core Recovery and Compositing Scheme

Core Identification	Date Extruded	Measured Sediment Volumes (L) Used in the Dredge Prism Composite
MW 24 R2B/3B	6/16/98	1.8
MW 25 R2B	6/15/98	1.8
MW 25 R3B	6/15/98	0.5
MW 27 R2B	6/15/98	1.7
MW 27 R3B	6/15/98	1.4
MW 29 R2B	6/15/98	0.9
MW 30 R2B	6/16/98	1.8
MW 30 R3B	6/16/98	0.7
MW 31 R2B	6/16/98	1.8
MW 37 R2B	6/16/98	1.8
MW 37 R3B	6/16/98	0.3
MW 40 R2B	6/16/98	1.6

4.0 Anaerobic Porewater Extraction

Seventeen sediment samples were received by STI between 5/14/98 and 5/27/98 for pore water extraction. The samples were identified as MWSS022RI, 024RI, 025RI, 028RI, 030RI, 031RI, 032RI, 034RI, 035RI, and 040RI and MWST039RI, 040RI, 043RI, 047RI, 048RI, 051RI, and 054RI.

Currently, a standard pore water extraction method for TBT is in the development stage. The following method was decided upon during discussions with Foster Wheeler. All handling of sediment and pore water was conducted under an anaerobic environment.

Sediment from each sample was placed in polycarbonate tubes and centrifuged at 9000 rpm for 30 minutes. Enough centrifuge tubes were filled to yield at least 200 mls pore water for each sample. The pore water was decanted and then a second centrifuge run was conducted on the pore water. This sample was dispensed into an appropriate nitrogen-purged container supplied by the analytical lab. For one sample (MWSS024RI), 1000 mls of pore water was extracted for MS/MSD sampling by the analytical lab. One method blank (MWST060RI) was prepared by processing reagent-grade water in the same manner as the sample.

An additional porewater extraction method was performed on a subset of eight sediment samples (MWSS024RI, MWSSO25RI, and MWST040RI, 043RI, 047RI, 048RI, 051RI, and 054RI). Instead of a second centrifuge run, the pore water was filtered through 0.45 micron silver membrane filters that were prewashed with 2% HCl and rinsed twice with deionized water. An additional method blank was prepared by processing reagent-grade water in the same manner as the sample including the filtration step (MWST060RIS).

Pore water samples were sent to MultiChem for TBT analysis between 5/21 and 6/2/98, as sample extractions were completed. Sample MWS0022 was unreported due to loss of pore fluid during centrifuging resulting from seal failure. The pore water index parameter results are presented in Table 2.

Table 2: Index Parameter Results for Pore Water Samples

Sample ID	Date Tested	Dissolved Oxygen (ppm)	Electrical Conductivity (micromhos)	Redox Potential (millivolts)	pH
MWSS022RI	5/22/98	0.20	27,400	-165.4	7.75
MWSS024RI	5/22/98	0.20	32,500	-171.4	7.28
MWSS025RI	5/28/98	0.60	26,300	-62.2	7.41
MWSS028RI	5/22/98	0.50	30,400	-161.3	7.29
MWSS030RI	5/22/98	0.30	32,300	-130.2	7.32
MWSS031RI	5/22/98	0.30	30,300	-180.8	7.38
MWSS032RI	5/22/98	0.20	26,200	-218.8	7.63
MWSS034RI	5/22/98	0.90	31,800	31.4	6.91
MWSS035RI	5/22/98	0.10	29,500	-194.5	7.48
MWST039RI	5/28/98	1.0	27,600	-6.8	5.61
MWST040RI	5/28/98	0.40	26,800	-129.6	7.08
MWST043RI	5/28/98	0.50	24,100	-163.6	7.43
MWST047RI	6/1/98	0.15	25,500	-121.8	7.19
MWST048RI	6/1/98	0.40	28,700	-129.0	7.37
MWST051RI	6/1/98	na	21,000	-137.9	7.10
MWST054RI	5/28/98	0.90	26,200	-89.9	7.01

5.0 Elutriate Tests

Two different types of elutriate tests were performed on the dredge prism composite: a modified elutriate test and a dredging elutriate test. The elutriate tests were prepared and run under ambient atmospheric conditions. The modified test was initiated on 7/1/98 and completed on 7/2/98 and the dredging elutriate test was started and completed on 7/2/98. A subset of the dredge prism composite sample used for the elutriate tests was collected on 7/1/98 and sent to MultiChem for analysis of VOCs, SVOCs, sulfide, pesticides/PCBs, ammonia, and TOC. This sample was identified as DPC-BKS1-7198.

The modified elutriate test was performed in general accordance with EPA/USACE methods (1994. Evaluation of dredged material proposed for discharge in waters of the US - Testing manual (Draft). EPA-823-B-94-002, Washington, D.C.). The slurry was mixed in a decontaminated glass carboy at a concentration of 150 g sediment (dry weight basis) per liter of site seawater for five minutes. Immediately afterward, compressed air was used to aerate the slurry for one hour. Upon completion of mixing, the carboy was allowed to stand undisturbed for 24 hours. The required amount of supernatant for both total and dissolved samples was siphoned off. The aliquot for total analysis (DPC-METT-7298) was dispensed to appropriate containers supplied by the analytical lab and preserved where necessary. The aliquot for dissolved analysis (DPC-METD-7298) was centrifuged to separate out the solids larger than 0.45 micron. The centrifuged supernatant was drawn off by glass syringe, dispensed to the appropriate containers and preserved where necessary. Samples were shipped to MultiChem for analysis of total and dissolved SVOCs, pesticides/PCBs, TOC, metals, and low level mercury.

The dredging elutriate test was conducted with the same methods as the modified elutriate test with the exception that only 10 g/L of sediment was used in the slurry, and the settling time was for only one hour. An aliquot for total analyses (DPC-DRET-7298), along with a duplicate sample (DPC-Duplicate-7298) was collected and dispensed to appropriate containers and preserved where necessary. Samples were shipped to MultiChem for analysis of total SVOCs, pesticides/PCBs, TOC, metals, and low level mercury.

Total suspended solids (TSS) was performed on elutriate samples from both tests by STI in accordance with Army Corps of Engineer Method EM 1110-2-5027. TSS results are shown in Table 3.

Centrifuged and non-centrifuged samples of the site seawater (DPC-WATT-7298 and DPC-WATD-7298) were collected as for the elutriate samples and shipped to MultiChem for analysis of total and dissolved SVOCs, pesticides/PCBs, TOC, metals, and low level mercury.

Table 3: Total Suspended Solids of Modified and Dredging Elutriate Tests

Sample ID	Total Suspended Solids (mg/L)
DPC-DRET-7298	19
DPC-METT-7298	24

6.0 Column Leach Test

One column leach test (CLT) was performed on the dredge prism composite in general accordance with Army Corps of Engineers methodology. Modifications were made to perform the tests under anaerobic conditions. Prior to the sediment being placed into the column apparatus, measurements of the inside wall height and the inside diameter of the column were taken. These measurements were then used to calculate column leach apparatus volume (sample volume capacity).

The column was assembled and a rinsate blank obtained by passing J.T. Baker "Ultra Resi-Analyzed" water through the system on 6/24/98. This blank was sent to MultiChem for analysis of SVOCs, pesticides/PCBs, TOC, metals, and low level mercury. The column was then filled with sediment and connected to a constant volume pump via stainless steel tubing to a supply of leachwater. Leachwater used for the test was J.T. Baker "Ultra Resi-Analyzed" reagent grade water that was purged with nitrogen gas prior to use in the column. This test was initiated on 6/24/98. Flow rates were maintained below 10^{-5} cm/sec for the duration of the test. Pre-cleaned, nitrogen-purged one liter glass collection bottles from MultiChem were used as collection vessels for the leachate. Alternating leachate samples were collected, consisting of approximately 1000 mls for organic analyses and 500 mls for inorganic analyses. The organic samples were sent to the lab in the collection bottles and the inorganic samples were dispensed under an anaerobic environment into appropriate containers provided by MultiChem for metals and mercury analyses. STI performed index parameter determinations on each bottle. Table 4 reports the index parameter results. The thin column leach test was terminated on 12/20/98 after the collection of 32.9 pore volumes.

Table 4: Index Parameter Measurements for the Thin Column Leach Test.

Date	Pore Volume Interval[1]	pH	Eh (mV)	EC (millimhos)	DO (ppm)	Fe (mg/L)	Turbidity (NTUs)
6/29/98	1.00	7.74	29	14.63	0.40	-	-
7/1/98	1.48	8.16	116.3	11.1	0.80	-	-
7/5/98	2.43	8.05	-83.1	6.7	0.20	-	-
7/8/98	3.00	8.20	-20.4	3.47	0.70	-	-
7/12/98	3.90	8.09	-20.6	2.44	0.30	-	-
7/17/98	4.86	8.10	-35.3	1.54	0.70	-	-
7/23/98	5.84	7.88	-81.6	0.88	0.50	-	-
7/25/98	6.50	8.50	-9.5	0.77	0.30	-	-
7/30/98	7.48	8.37	-4	0.53	0.15	-	-
8/5/98	8.26	8.30	-2.5	0.46	1.10	0.07	-
8/9/98	9.19	8.57	-17.6	0.33	0.40	0.07	-
8/14/98	10.18	8.55	-12.7	0.28	0.30	0.1	34.7
8/19/98	11.16	8.53	-44	0.31	0.15	0.18	66.9
8/23/98	11.89	8.57	11.9	0.32	0.35	0.16	71.4
8/28/98	12.82	8.85	81	0.3	0.40	0.18	72.8
9/1/98	13.48	8.87	-6.3	0.35	0.40	0.18	98.0
9/7/98	14.41	8.76	-25.3	0.26	0.40	0.26	106.7
9/10/98	14.94	9.11	3	0.25	0.30	0.24	108.8
9/16/98	15.88	9.17	-20.6	0.24	0.30	0.24	114.5
9/21/98	16.61	9.01	-33.1	0.20	0.25	0.31	102.1
9/28/98	17.58	8.96	-6.3	0.21	0.30	0.22	92.0
10/1/98	18.09	8.66	17.6	0.25	0.30	0.20	82.0
10/8/98	19.05	8.88	6.8	0.20	0.50	0.15	76.5
10/10/98	19.58	9.26	13.0	0.15	0.40	0.16	75.6
10/15/98	20.54	9.50	12.5	0.17	0.40	0.15	88.2
10/19/98	21.21	9.61	-15.8	0.16	0.35	0.18	90.5
10/24/98	22.16	9.48	15.3	0.15	0.40	0.13	85.7
10/28/98	22.86	9.59	-27.3	0.18	0.45	0.12	74.7
11/2/98	23.81	9.71	-14.6	0.17	0.50	0.17	81.3
11/5/98	24.33	9.76	-18.2	0.17	0.40	0.16	80.6
11/10/98	25.28	9.78	-17.6	0.16	0.45	0.14	79.5
11/13/98	25.89	9.91	-15.3	0.15	0.40	0.13	72.6
11/18/98	26.85	9.83	-6.5	0.14	0.20	0.13	80.5
11/21/98	27.42	9.82	-4.9	0.15	0.50	0.12	75.4
11/26/98	28.38	9.79	6.7	0.14	0.40	0.08	72.3
11/30/98	29.06	9.83	-11.2	0.13	0.50	0.08	57.8
12/5/98	30.03	9.68	11.0	0.13	0.40	0.08	52.7
12/10/98	31.00	Na	na	na	Na	na	na
12/15/98	31.95	Na	na	na	Na	na	na
12/20/98	32.92	9.81	11.2	0.11	0.55	0.07	39.7

na: not analyzed at the request of Foster Wheeler

[1] Pore volume was calculated using total porosity measured during the column setup.

7.0 Column Settling Test

One column settling test was performed on the dredge prism composite (DPC). The test was performed in general accordance with U. S. Army Corps of Engineers Method EM 1110-2-5027. Results of the column settling tests are presented in Tables 5 through 8 and Graphs 1 through 5.

The DPC sediment was mixed with marine site water supplied by Foster Wheeler to a concentration of 150 g/L (dry solids/water). To limit particle settling during the process, the slurry was delivered to the settling column while mixing with a mechanical stirrer until delivery was complete. Compressed air was used for mixing to keep the slurry in the column homogenous during loading. Analysis was initiated (time zero) when the delivery of the slurry was complete. An initial subsample of the mixed slurry was tested for total solids (TS) and found to be 121 g/l (salt-corrected to 97 g/l). The slurry mixture was observed to contain some coarse gravel and sand; therefore, the initial TS concentration was lower than 150 g/l due to the coarser material settling out and not being represented in the subsample. The coarse solids settled to the bottom of the column quickly and became difficult to distinguish after approximately 4 hours. The flocculated solids exhibited zone settling and supernatant was available at the 1 hour interval . The supernatant had a fairly high total suspended solids (TSS) until the 6 hour interval and then steadily decreased throughout the test. Settling column analysis was initiated on 7/8/98 and concluded on 7/23/98.

Table 5: Parameter Determinations

Sample ID	Specific Gravity[1]	Total Solids[2] (g/L)	Initial Concentration[3] (mg/L)
Dredge Prism Composite	est 2.7	121	626

[1] Specific gravity was estimated
[2] Initial dredge slurry total solids concentration determined averaging four port sample concentrations at time zero.
[3] Initial concentration of supernatent is the average of all one hour readings..

Table 6: Total Suspended Solids for Dredge Prism Composite.
Collection Intervals, Concentration, and Percent of Initial Concentration

Elapsed Time (hours)	Port Height from Base (ft)	Total Suspended Solids (mg/L)	% of Initial Concentration [1]
1	6.5	642	100
1	6.0	609	100
2	6.5	280	45
2	6.0	388	62
2	5.5	425	68
2	5.0	367	59
2	4.5	606	97
4	6.5	186	30
4	6.0	229	37
4	5.5	241	39
4	5.0	274	44
4	4.5	264	42
4	4.0	243	39
6	6.5	97	15
6	6.0	133	21
6	5.5	135	22
6	5.0	142	23
6	4.5	170	27
6	4.0	172	28
6	3.0	165	26
12	6.5	40	6
12	6.0	90	14
12	5.5	50	8
12	5.0	69	11
12	4.5	74	12
12	4.0	69	11
12	3.0	51	8
12	2.0	78	12
24	6.5	32	5
24	6.0	33	5
24	5.5	35	6
24	5.0	45	7
24	4.5	87	14
24	4.0	22	4
24	3.0	24	4
24	2.0	48	8
48	6.0	34	5
48	5.5	43	7
48	5.0	53	9
48	4.5	52	8
48	4.0	32	5
48	3.0	36	6
48	2.0	38	6

[1] Initial concentration: 626 mg/l.

Table 6, continued: Total Suspended Solids for Dredge Prism Composite.
Collection Intervals, Concentration, and Percent of Initial Concentration

Elapsed Time (hours)	Port Height from Base (ft)	Total Suspended Solids (mg/L)	% of Initial Concentration [1]
96	6.0	19	3
96	5.5	14	2
96	5.0	2	0
96	4.5	13	2
96	4.0	19	3
96	3.0	33	5
96	2.0	26	4
144	6.0	29	5
144	5.5	21	3
144	5.0	23	4
144	4.5	12	2
144	4.0	33	5
144	3.0	28	4
144	2.0	26	4
216	6.0	14	2
216	5.5	38	6
216	5.0	22	4
216	4.5	25	4
216	4.0	12	2
216	3.0	0	0
216	2.0	11	2
288	6.0	5	1
288	5.5	12	2
288	5.0	2	0
288	4.5	7	1
288	4.0	14	2
288	3.0	0	0
288	2.0	13	2
360	5.5	0	0
360	5.0	16	2
360	4.5	15	2
360	4.0	7	1
360	3.0	14	2
360	2.0	12	2

[1] Initial concentration: 626 mg/l.

Table 7: Turbidity Determinations for Dredge Prism composite
Sample Collection Intervals and Turbidity (NTU)

Elapsed Time (hours)	Port Height from Base (ft)	Turbidity[1] (NTU)
1	6.5	585
1	6.0	670
2	6.5	358
2	6.0	369
2	5.5	412
2	5.0	442
2	4.5	523
4	6.5	225
4	6.0	244
4	5.5	271
4	5.0	275
4	4.5	267
4	4.0	256
6	6.5	111
6	6.0	127
6	5.5	141
6	5.0	137
6	4.5	151
6	4.0	157
6	3.0	165
12	6.5	26
12	6.0	36
12	5.5	55
12	5.0	63
12	4.5	64
12	4.0	67
12	3.0	69
12	2.0	82
24	6.5	38
24	6.0	39
24	5.5	39
24	5.0	40
24	4.5	40
24	4.0	41
24	3.0	42
24	2.0	45
48	6.0	34
48	5.5	34
48	5.0	34
48	4.5	34
48	4.0	34
48	3.0	35
48	2.0	38

[1] Turbidity analysis performed following ASTM D1889 using a photoelectric nephelometer.

Table 7, continued: Turbidity Determinations for Dredge Prism composite
Sample Collection Intervals and Turbidity (NTU)

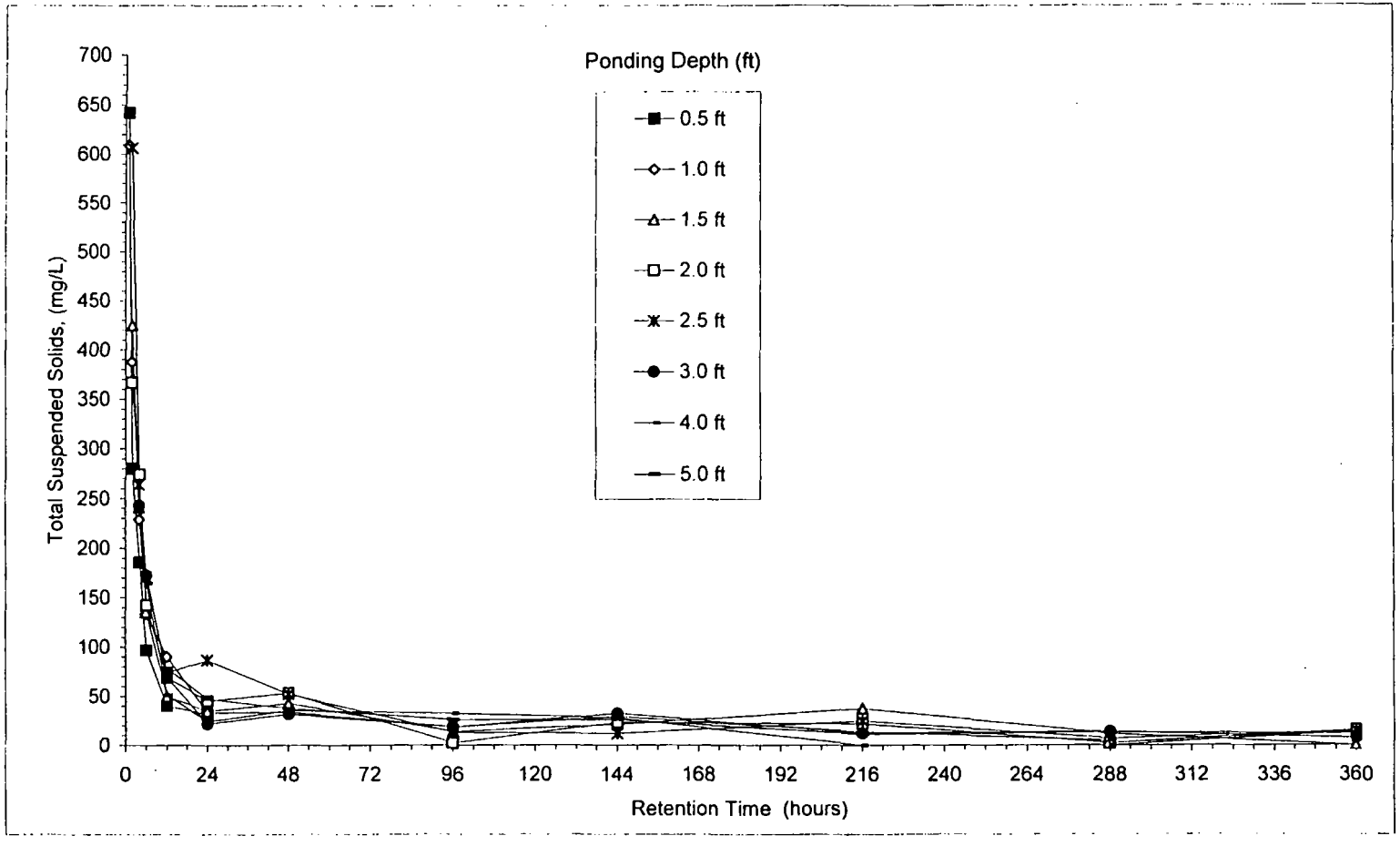
Elapsed Time (hours)	Port Height from Base (ft)	Turbidity[1] (NTU)
96	6.0	25
96	5.5	23
96	5.0	23
96	4.5	24
96	4.0	23
96	3.0	23
96	2.0	25
144	6.0	17
144	5.5	18
144	5.0	18
144	4.5	18
144	4.0	17
144	3.0	19
144	2.0	22
216	6.0	11
216	5.5	12
216	5.0	12
216	4.5	12
216	4.0	12
216	3.0	12
216	2.0	12
288	6.0	10
288	5.5	11
288	5.0	11
288	4.5	10
288	4.0	11
288	3.0	11
288	2.0	11
360	5.5	10
360	5.0	10
360	4.5	10
360	4.0	10
360	3.0	11
360	2.0	10

[1] Turbidity analysis performed following ASTM D1889 using a photoelectric nephelometer.

Table 8: Interface Heights for Dredge Prism Composite

Elapsed Time (hours)	Surface Water Height from base (ft)	Solids Interface Height from base (ft)	Coarse Material Height from base (ft) & comments
0.00	6.97	6.97	0.39
0.11	6.97	6.85	0.45
0.18	6.97	6.75	0.52
0.30	6.97	6.59	0.64
0.63	6.97	6.15	0.65
0.90	6.97	5.83	0.65
1	6.97	5.69	0.65
2	6.95	4.99	0.65
2	6.95	4.29	0.65
4	6.87	3.10	0.65
6	6.80	2.29	0.65
12	6.70	1.69	0.65
24	6.60	1.49	0.65
48	6.46	1.32	0.65
96	6.36	1.22	0.65
144	6.26	1.18	0.65
216	6.14	1.15	0.65
288	6.02	1.13	0.65
360	5.89	1.13	0.65

Graph 1: Retention Time vs. Total Suspended Solids.



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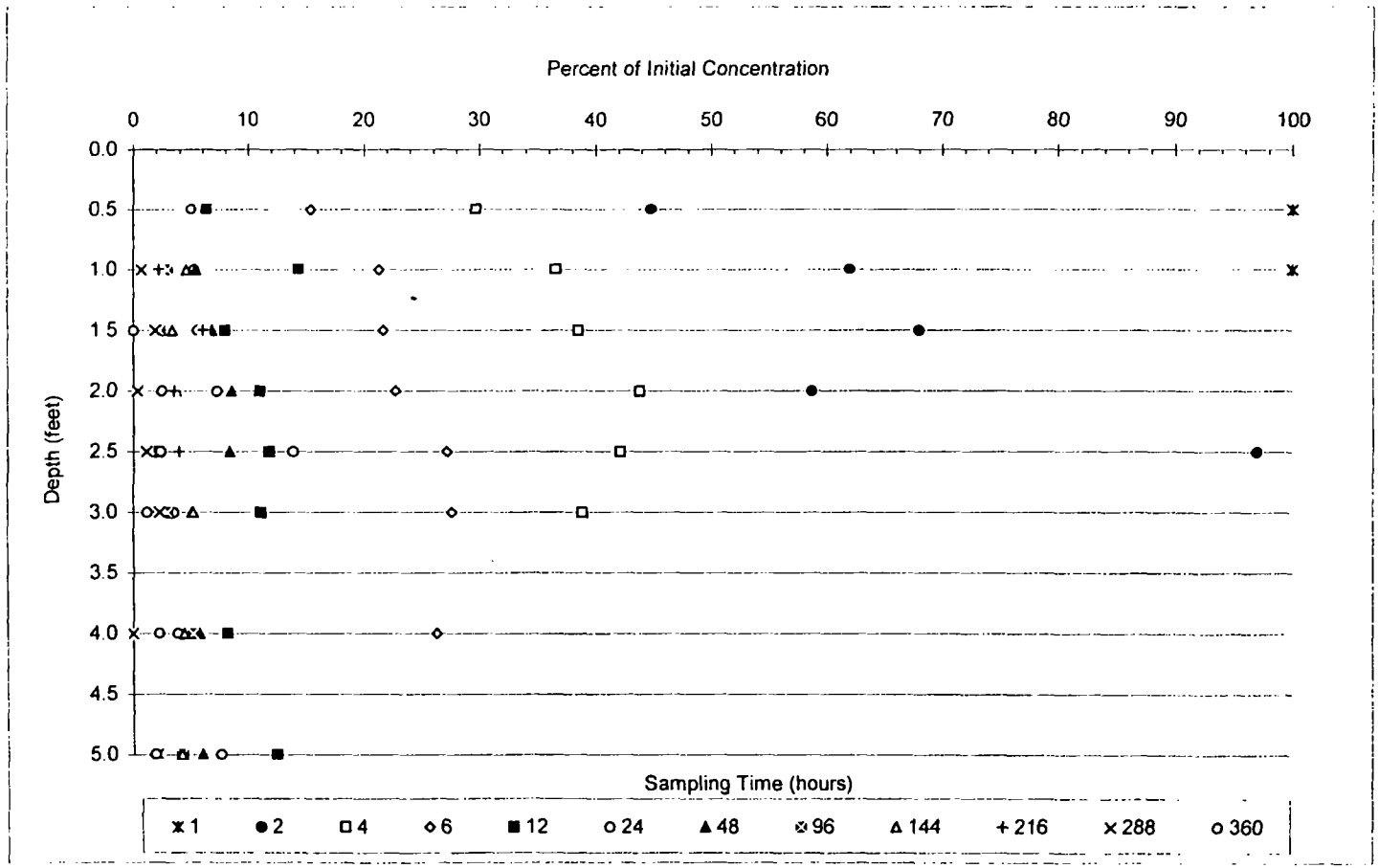
14

Graph 2: Concentration Profile



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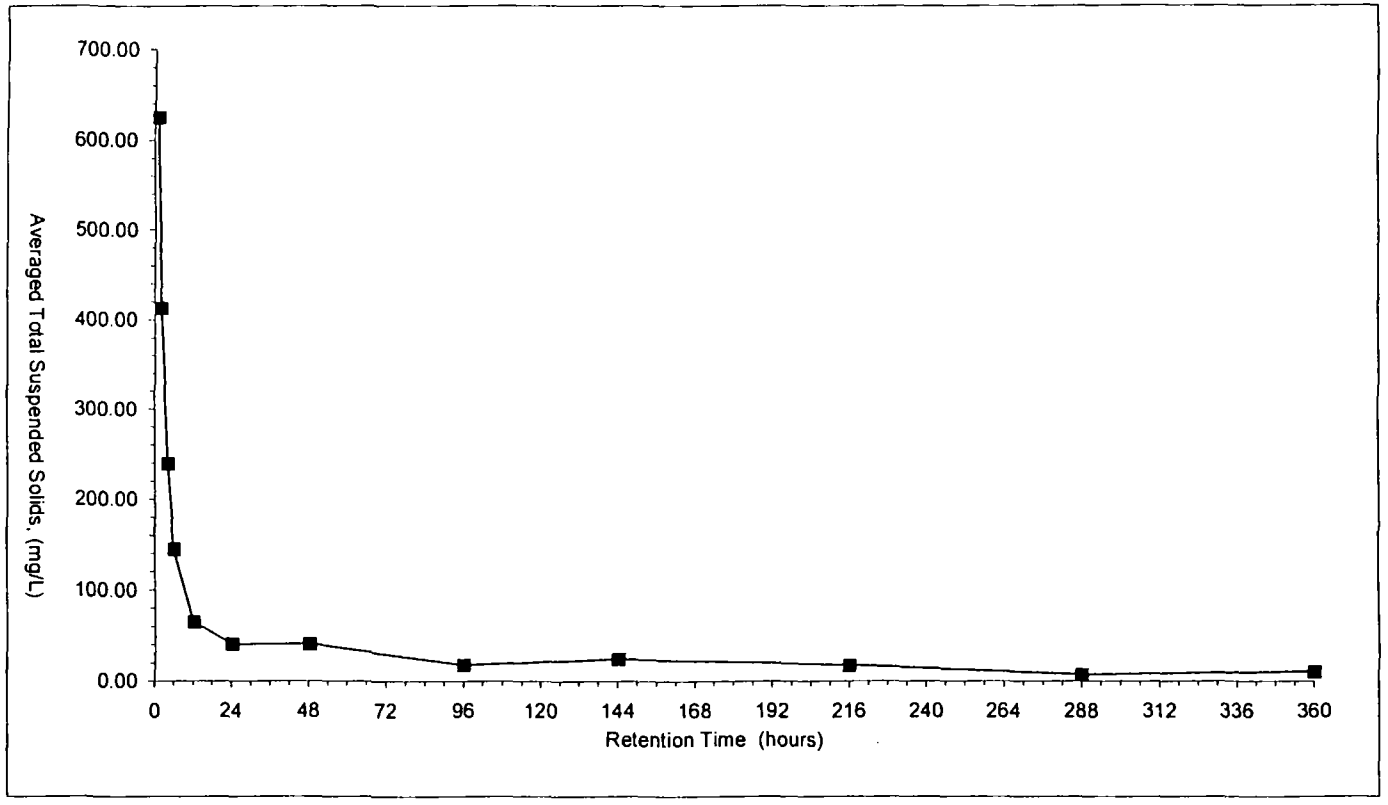
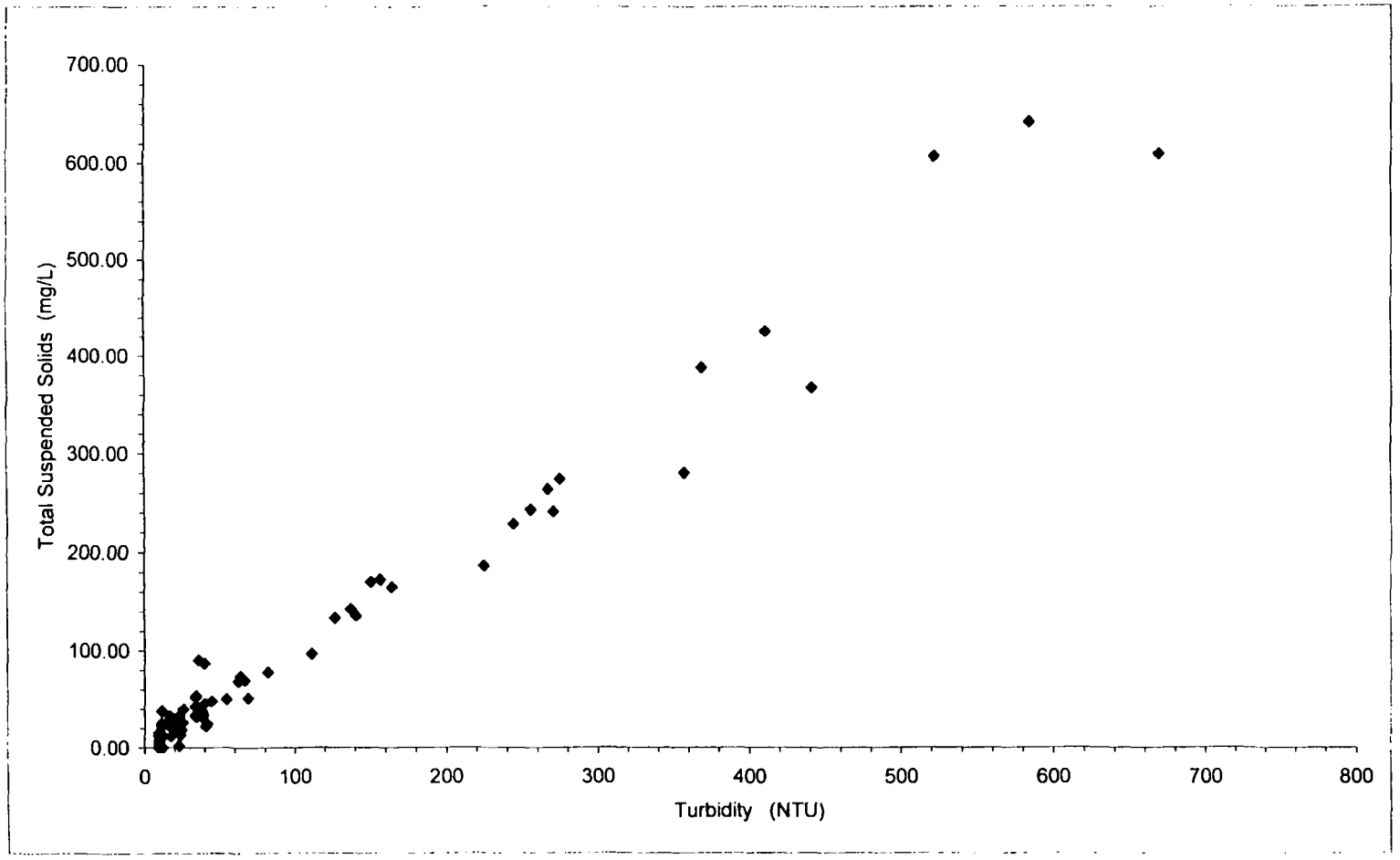
Graph 3: Retention Time vs. Averaged Total Suspended Solids[1]

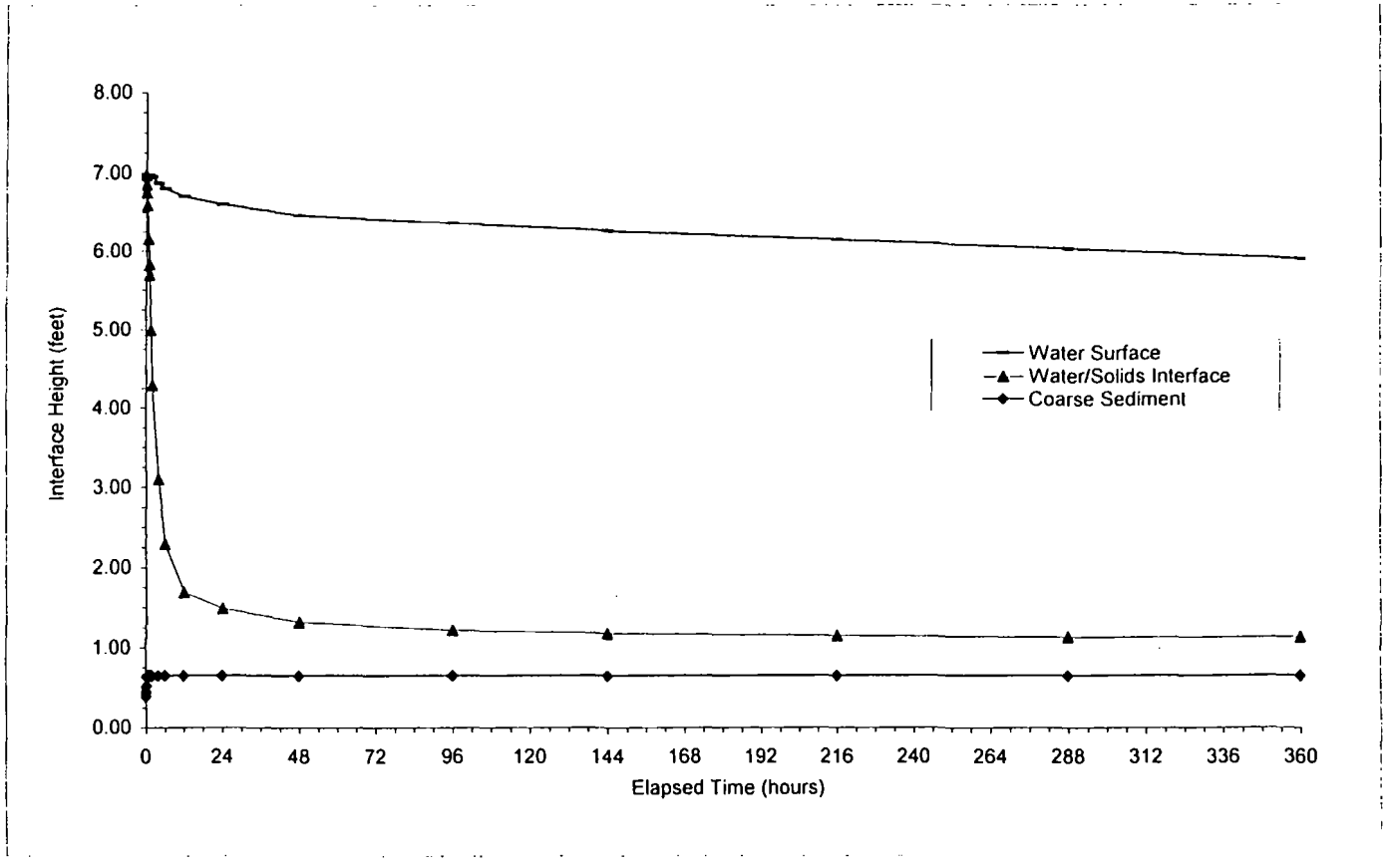


[1] TSS plotted are averages calculated from all TSS values taken at a given time interval.

Graph 4: Turbidity vs. Total Suspended Solids



Graph 5: Elapsed Time vs. Interface Heights[1]



[1] Apparent decrease in water surface height reflects cumulative volume loss due to sample extractions.

APPENDIX G

APPENDIX G

BIOLOGICAL TEST RESULTS

TOXICITY TEST NO. 590-1

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 590-1
Title: *Rhepoxynius abronius* 10-day sediment toxicity test.
Protocol: NAS-XXX-RA4, April 9, 1996. Revised October 31, 1997. Complies with: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP 1995), with modifications as specified by the Puget Sound Dredged Disposal Analysis Program.

STUDY MANAGEMENT

Study Sponsor: Foster Wheeler Environmental, 10900 N.E. 8th St., Suite 1300, Bellevue, WA 98004
Sponsor's Study Monitor: Mr. Gary Braun
Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, Oregon 97365.
Test Location: Newport Laboratory.
Laboratory's Study Personnel: R.S. Caldwell, Ph.D., Proj. Mngr./Study Dir.; L.K. Nemeth, B.A., QA Officer; M.S. Redmond, M.S., Aq. Toxicol.; G.J. Irissarri, Aq. Toxicol.; B.D. Crowe, B.S., Sr. Tech; B. Moran, M.S., Tech.; S. Bione, B.S., Tech.; E. Coffey, Tech.
Study Schedule:
Test Beginning: 5-29-98, 1300 hrs.
Test Ending: 6-8-98, 1300 hrs.
Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.
Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).
Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Control Sediment: The control sediment was collected by Parametrix, Inc., from West Beach, Whidbey Island, Washington, on 5-25-98, and received with the test organism shipment on 5-27-98. It was stored at 4°C in the dark, and then homogenized before use in the test.
Test Sediments: Unidentified marine sediments. Details are as follows:

NAS Sample No.	0690F	0691F	0692F	0721F	0722F
Foster Wheeler Sample No.	MWAS022R1	MWAS024R1	MWAS025R1	MWAT040R1	MWAT049R1
Collection Date	5-15-98	5-15-98	5-15-98	5-18-98	5-18-98
Receipt Date	5-18-98	5-18-98	5-18-98	5-20-98	5-20-98
Interstitial salinity (ppt)	28.5	27.0	28.0	27.0	28.0

NAS Sample No.	0723F	0727F	0728F	0729F	0730F
Foster Wheeler Sample No.	MWAT054R1	MWAT039R1	MWAT043R1	MWAT048R1	MWAT052R1
Collection Date	5-18-98	5-19-98	5-19-98	5-19-98	5-19-98
Receipt Date	5-20-98	5-21-98	5-21-98	5-21-98	5-21-98
Interstitial salinity (ppt)	*	25.0	26.0	24.0	24.0

NAS Sample No.	0749F	0750F	0751F
Foster Wheeler Sample No.	MWRC208R1	MWRC209R1	MWRC210R1
Collection Date	5-22-98	5-22-98	5-22-98
Receipt Date	5-28-98	5-28-98	5-28-98
Interstitial salinity (ppt)	28.0	29.0	28.0

*Insufficient water available for salinity measurement.

Storage: Stored locked at 4°C in the dark in capped containers until used.
Treatments: Homogenized. After addition to beakers, test samples 0729F and 0730F were adjusted to increase interstitial salinity as per PSEP (1995).

TEST WATER

Source: Yaquina Bay, Oregon
Date of Collection: 5-28-98
Water Quality: Salinity 27.0 ppt; pH 7.5
Pretreatment: Filtered to ≤0.40 μm, aerated.

TEST ORGANISMS

Species: *Rhepoxynius abronius*, amphipod
Size/Weight: adult
Source: Parametrix, Inc., Kirkland, WA. Collected from West Beach, Whidbey Island, WA. Received 5-27-98.
Acclimation: Average conditions during acclimation were: temperature, 13.2 ± 4.7°C; salinity 29.7 ± 0.6 ppt; dissolved oxygen 5.7 ± 2.8 mg/L; pH 7.4 ± 0.3; photoperiod, constant illumination.

TEST PROCEDURES AND CONDITIONS

Test Chambers: 1 L borosilicate glass beakers covered with watchglasses.
Test Volumes: 175 ml of test or control sediment; 950 ml total volume.
Replicates/Treatment: 5 (plus one water quality replicate, and two sacrificial replicates for day 0 and day 5 interstitial ammonia and sulfide measurements)
Sediment Salinity Adjustment: Test samples 0729F and 0730F were adjusted to increase interstitial salinity as per PSEP (1995).
Organisms/Treatment: 100 (20/replicate)
Water Volume Changes per 24 hr: None
Aeration: Yes, at least 2 cm above the sediment surface.
Feeding: None.
Acceptance Criteria: Results are valid if mean control mortality does not exceed 10%, and does not exceed 20% in any one replicate. Additionally, mortality in the reference sediments must be ≤20% over the negative control.
Effects Criteria: 1) mortality after 10 days, 2) daily emergence of amphipods from the test sediments, and 3) failure of surviving amphipods to rebury at the end of the exposure period. Death is defined as no visible appendage movement or response to tactile stimulation.
Water Quality and Other Test Conditions: Ammonia-N and sulfide were measured in the pore water of one replicate test chamber per treatment on days 0, 5, and 10. Pore water was obtained by centrifugation. The temperature, dissolved oxygen, salinity, and pH were measured in all but the day 0 and 5 sacrificial beakers on days 0 and 10, and in one replicate test chamber daily. Ammonia-N and sulfide were measured in the overlying water of one replicate test chamber on days zero and 10. Sulfide and ammonia-N analyses were by the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis. The values of individual water quality measurements are to be found in the raw data (Appendix II). The means, and minimum and maximum values for the water quality parameters during the test are listed in Table 1. The photoperiod was constant light.

DATA ANALYSIS METHODS

The percent amphipod mortality and percent of surviving amphipods failing to rebury at the end of the test was determined from the final observations according to the formulas:

Percent Mortality = 100 x ([initial amphipods - surviving amphipods]/initial amphipods)
Percent Survivors not Reburied = 100 x ([surviving amphipods - number survivors reburied]/surviving amphipods
Percent Total Effective Mortality = 100 x ([initial amphipods - surviving amphipods]+ [surviving amphipods - number survivors reburied])/initial amphipods

Another endpoint was the sum of observed daily sediment emergence events in a test beaker throughout the test. Control and treatment means and standard deviations for the biological endpoints described above and for water quality data were computed using Microsoft EXCEL v5.0.

Values of the four endpoints (mortality, reburial, total effective mortality, and emergence) for the test sediments were statistically compared against each of the three reference sediments using ToxCalc v5.0.15N. Proportional survival and survivors reburied were analyzed rather than proportional mortality and survivors not reburied due to software limitations; this does not affect the significance results. An arcsine square root transformation was performed on proportional data before analysis. Following transformation and determination of normality and homogeneity of variances, one-tailed homoscedastic or heteroscedastic t-tests were conducted at the 0.05 level of significance.

PROTOCOL DEVIATIONS

1. The overlying water salinity value was slightly below the specified limits of 28 ± 1 ppt in one water quality beaker on day 2 of the test (26.5 ppt), and higher in three beakers on day 10 (30.0 ppt). These deviations are not considered to be serious and should not adversely affect the test results.

2. Client-specified measurement of overlying water ammonia was inadvertently omitted on days 3 and 6. However, maximum ammonia-N measured on days 0 and 10 was 3.2 mg/L, so ammonia did not appear to be a problem with these sediments.

REFERENCE TOXICANT TEST

The reference toxicant test is a standard multi-concentration toxicity test using cadmium as $CdCl_2 \bullet 2\frac{1}{2} H_2O$, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. Reference toxicant test raw data and the applicable control chart are included in Appendix III.

Test No.: 999-897
Reference Toxicant and Source: $CdCl_2 \bullet 2.5H_2O$, Mallinckrodt, Lot No. TNZ, 1.0 mg/ml stock prepared 7-16-97.
Test Date: 5-29-98
Dilution Water Used: Yaquina Bay, Oregon, seawater
Result: 96-hr LC50, 0.16 mg/L Cd. This result is within the laboratory's control chart warning limits (0.00 - 2.83 mg/L).

RESULTS AND CONCLUSIONS

Water quality data are summarized in Table 1. The means and standard deviations of the survival, reburial and emergence responses for each sediment are summarized in Table 2. Table 3 gives the final interstitial salinities. Tables 4 and 5 summarize the interstitial ammonia-N and sulfide concentrations in the sediments of each sacrificial beaker on days 0 and 10.

The test met the acceptability criterion for control survival: mean survival in the control was 99.0%. Control survival was ≥ 95% in individual replicates.

Mortality in sample MWAS024R1 (18.0%) was significantly greater than that in reference MWRC208R1 (5.0%), MWRC209R1 (3.0%), and MWRC210R1 (6.0%). Mortality in MWAT054R1 (9.0%) was also significantly greater than that in MWRC209R1.

The same significance pattern was observed in percent total effective mortality (MWAS024R1 = 20%, MWRC208R1 = 7.0%, MWRC209R1 = 4.0%, MWRC210R1 = 7.0%, MWAT054R1 = 11.0%), and additionally total effective mortality in sample MWAT052R1 (10.0%) was significantly different from that in MWRC209R1. No significant differences were detected in percent survivors failing to rebury.

Emergence data showed four samples with significantly higher emergence than in reference MWRC209R1 (1.8): MWAS024R1 (7.2), MWAT054R1 (3.6), MWAT039R1 (3.6), and MWAT052R1 (4.4). However, in no case were these emergence values particularly high. Mean control emergence (6.4) was actually greater than that in three of the significant samples, but likely because of higher variability was not found to be significant.

STUDY APPROVAL

Project Manager/Study Director — Date 7/23/98

Quality Assurance Unit — Date 7 23 98

Manager, Toxicology — Date 7/23/98

Table 1. Summary of overlying water quality conditions prevailing during the *Rhepoxynius abronius* 10-day test.

Water Quality Parameter	Mean ± SD	Minimum	Maximum	N
Temperature (°C)	15.2 ± 0.3	14.7	15.8	294
Dissolved Oxygen (mg/L)	7.9 ± 0.2	7.2	8.3	315
Salinity (ppt)	28.1 ± 0.7	26.5	30.0	294
pH	8.0 ± 0.2	7.3	8.7	294
Total Sulfide (mg/L)	---	<0.01	<0.01	28
Total Ammonia-N (mg/L)	---	<0.2	3.2	28

Table 2. Means and standard deviations (n=5) of sediment emergence, 10-day mortality, failure to rebury, and percent total effective mortality of *Rhepoxynius abronius* exposed to sediments.

Sample Description	Emergence[1] (no./replicate)		Percent Mortality		Percent Survivors Failing to Rebury	Percent Total Effective Mortality	
MWAS022R1 (NAS #0690F)	3.6 ± 2.7		7.0 ± 4.5		1.1 ± 2.4	8.0 ± 4.5	
MWAS024R1 (NAS #0691F)	7.2 ± 4.9	b	18.0 ± 8.4	abc	2.5 ± 5.6	20.0 ± 10.0	abc
MWAS025R1 (NAS #0692F)	5.6 ± 4.4		11.0 ± 8.2		0.0 ± 0.0	11.0 ± 8.2	
MWAT040R1 (NAS #0721F)	2.8 ± 1.5		4.0 ± 4.2		2.1 ± 2.8	6.0 ± 4.2	
MWAT049R1 (NAS #0722F)	1.2 ± 1.6		4.0 ± 5.5		1.1 ± 2.5	5.0 ± 7.1	
MWAT054R1 (NAS #0723F)	3.6 ± 1.5	b	9.0 ± 4.2	b	2.2 ± 3.0	11.0 ± 4.2	b
MWAT039R1 (NAS #0727F)	3.6 ± 1.3	b	6.0 ± 2.2		2.2 ± 3.0	8.0 ± 4.5	
MWAT043R1 (NAS #0728F)	1.6 ± 1.7		5.0 ± 5.0		0.0 ± 0.0	5.0 ± 5.0	
MWAT048R1 (NAS #0729F)	3.4 ± 6.1		10.0 ± 9.4		2.3 ± 3.1	12.0 ± 9.7	
MWAT052R1 (NAS #0730F)	4.4 ± 1.7	b	6.0 ± 6.5		4.1 ± 4.2	10.0 ± 3.5	b
control (NAS #0748F)	6.4 ± 4.4		1.0 ± 2.2		0.0 ± 0.0	1.0 ± 2.2	
MWRC208R1 (NAS #0749F)	3.0 ± 3.3		5.0 ± 3.5		2.1 ± 2.8	7.0 ± 2.7	
MWRC209R1 (NAS #0750F)	1.8 ± 1.3		3.0 ± 4.5		1.0 ± 2.2	4.0 ± 4.2	
MWRC210R1 (NAS #0751F)	4.0 ± 5.2		6.0 ± 4.2		1.0 ± 2.2	7.0 ± 2.7	

[1] Daily emergence counts include all amphipods observed on or above the sediment surface whether living or dead.
[a] Significantly different ($p \leq 0.05$) from reference sediment MWRC208R1.
[b] Significantly different ($p \leq 0.05$) from reference sediment MWRC209R1.
[c] Significantly different ($p \leq 0.05$) from reference sediment MWRC210R1.

Table 3. Final sediment interstitial salinity for sediments tested for 10 days with the amphipod *Rhepoxynius abronius*.

Sample Description	Salinity (ppt)
MWAS022R1 (NAS #0690F)	28.8 ± 0.7
MWAS024R1 (NAS #0691F)	27.6 ± 0.5
MWAS025R1 (NAS #0692F)	28.0 ± 1.2
MWAT040R1 (NAS #0721F)	28.6 ± 1.1
MWAT049R1 (NAS #0722F)	29.0 ± 0.5
MWAT054R1 (NAS #0723F)	28.5 ± 1.2
MWAT039R1 (NAS #0727F)	28.3 ± 0.8
MWAT043R1 (NAS #0728F)	28.1 ± 0.9
MWAT048R1 (NAS #0729F)	28.3 ± 1.5
MWAT052R1 (NAS #0730F)	27.8 ± 1.0
control (NAS #0748F)	28.2 ± 1.1
MWRC208R1 (NAS #0749F)	28.6 ± 0.9
MWRC209R1 (NAS #0750F)	28.3 ± 1.2
MWRC210R1 (NAS #0751F)	28.7 ± 0.8

Table 4. Sediment interstitial ammonia-N for sediments tested for 10 days with the amphipod *Rhepoxynius abronius*.

Sample Description	Ammonia-N in mg/L		
	day 0	day 5	day10
MWAS022R1 (NAS #0690F)	2.0	1.0	1.0
MWAS024R1 (NAS #0691F)	10.0	2.0	1.0
MWAS025R1 (NAS #0692F)	7.0	4.0	1.0
MWAT040R1 (NAS #0721F)	7.0	4.0	2.0
MWAT049R1 (NAS #0722F)	5.0	4.0	3.0
MWAT054R1 (NAS #0723F)	1.0	2.0	2.0
MWAT039R1 (NAS #0727F)	7.0	4.0	4.0
MWAT043R1 (NAS #0728F)	8.0	4.0	1.0
MWAT048R1 (NAS #0729F)	2.0	1.0	2.0
MWAT052R1 (NAS #0730F)	4.0	3.0	3.0
control (NAS #0748F)	*	*	*
MWRC208R1 (NAS #0749F)	19.0	11.0	10.0
MWRC209R1 (NAS #0750F)	18.0	11.0	5.0
MWRC210R1 (NAS #0751F)	14.0	6.0	3.0

* not enough sample for analysis

Table 5. Sediment interstitial sulfide for sediments tested for 10 days with the amphipod *Rhepoxynius abronius*.

Sample Description	Sulfide in mg/L		
	day 0	day 5	day10
MWAS022R1 (NAS #0690F)	<0.1	<0.1	<0.1
MWAS024R1 (NAS #0691F)	<0.1	<0.1	<0.1
MWAS025R1 (NAS #0692F)	<0.1	<0.1	<0.1
MWAT040R1 (NAS #0721F)	<0.1	<0.1	<0.1
MWAT049R1 (NAS #0722F)	<0.1	<0.1	<0.1
MWAT054R1 (NAS #0723F)	<0.1	<0.1	<0.1
MWAT039R1 (NAS #0727F)	<0.1	<0.1	<0.1
MWAT043R1 (NAS #0728F)	<0.1	<0.1	<0.1
MWAT048R1 (NAS #0729F)	<0.1	<0.1	<0.1
MWAT052R1 (NAS #0730F)	<0.1	<0.1	<0.1
control (NAS #0748F)	*	*	*
MWRC208R1 (NAS #0749F)	<0.1	<0.1	<0.1
MWRC209R1 (NAS #0750F)	<0.1	<0.1	<0.1
MWRC210R1 (NAS #0751F)	<0.1	<0.1	<0.1

* not enough sample for analysis

APPENDIX I

PROTOCOL

TEST PROTOCOL

AMPHIPOD, RHEPOXYNIUS ABRONIUS
10-DAY SOLID PHASE SEDIMENT BIOASSAY

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this study is to identify marine test sediments that are toxic to a benthic marine amphipod.

1.2 Summary of Method: The 10-day static test is performed using adult amphipods obtained from a wild population by dredging. Test sediments are placed in the bottom of 1 liter glass beakers used as test vessels which are then filled with clean seawater. Five replicate containers for each test sediment, reference site sediment, and the collection site control sediment, each containing 20 test organisms, are employed. Mortality, emergence from the sediment during exposure, and failure to rebury in clean sediment after the test are the response criteria used. The mean ± S.D. for each treatment and test endpoint is given in the final report. Between-treatment comparisons may be made with Student's t-test, Wilcoxon's Two-Sample test, or Mann-Whitney U test, where each treatment is compared to the control or the reference sediment.

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:

_____
_____
_____

2.2 Sponsor's Study Monitor:

_____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
Yaquina Bay Road, P.O. Box 1437
Newport, OR 97365

2.4 Test Location: _____

2.5 Laboratory's Personnel to be Assigned to the Study:
Project Manager/Technical Director: _____
Qual. Assurance Officer: _____
Aquatic Biologist: _____
Aquatic Biologist: _____

2.6 Proposed Testing Schedule: Tests to begin within 14 days (8 weeks with samples under nitrogen for PSDDA) of sample collection. Reference toxicant test to be run concurrently.

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are marine sediments with interstitial water salinity of at least 25 ppt (at least 15 ppt for dredged material which is then salinity-adjusted). The collected sediments are placed in solvent and acid cleaned 1 L glass jars fitted with TFE-lined screw caps. The jars are filled completely so that there is no air space. At the laboratory, the samples may be stored at 4°C in the dark in the original sealed containers for up to 14 days (8

weeks with samples under nitrogen for PSDDA) prior to testing. A negative control sediment is from a clean site (the amphipod collection site), normally in Yaquina Bay, OR. In addition, a reference sediment, a clean sediment with physical characteristics similar to the test sediments, may also be employed as a control.

4. TEST WATER

Test water is filtered Yaquina Bay seawater adjusted to a salinity of 28 ppt. The water is pumped daily from Yaquina Bay into a 6000 gal seasoned fiberglass reservoir from which it is supplied under pump pressure to the laboratory. Filtration is accomplished using a sand filter followed by a medium porosity (10-25 um) cartridge filter, then a ≤0.45μm filter. An alternative seawater supply of similar quality may be used. Seawater should be held at ≤15°C for ≤2 days prior to test initiation.

5. TEST ORGANISMS

5.1 Species: Marine amphipod, Rhepoxynius abronius.

5.2. Source: Field collected from the lower portion of Yaquina Bay, OR in fine to medium size clean sand (mean grain size 0.16 mm) along the edge of the channel by short tows of a stainless steel biological dredge. Surface and bottom seawater salinity and temperature are measured at the collection site, and sediment temperature is recorded from the first and last dredge sample. The dredged sediments are sieved in the field using a 1.0 mm screen and the recovered amphipods, along with miscellaneous debris, are washed into plastic pails of fresh seawater and returned promptly to the laboratory. Alternatively, amphipods may be collected from Whidbey Island, WA.

5.3. Laboratory Handling: Pails containing the amphipods are placed in a laboratory seawater tray for temperature control and supplied with gentle aeration. As soon as possible after collection, amphipods and associated animals and detritus, are removed from the holding vessel using a fine mesh aquarium dip net and placed into pyrex glass sorting trays. The test organisms are picked from the detritus using a large bore eye dropper and 100 amphipods each are placed into small plastic freezer containers (9 cm x 9 cm x 6 cm) holding a 1 cm layer of clean sediment from the collection area. Freezer containers are immersed in a seawater tray provided with a continual flow of fresh seawater and held, under constant illumination for at least 2 days, but no longer than 10 days prior to the beginning of the test.

5.4 Age at Study Initiation: *Adult*

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are 1000 ml glass beakers. The beakers are covered with lids to minimize evaporation of volatile compounds. Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or room. Minimal aeration (approx. 100 bubbles/min.) is supplied through a glass pipet with the tip placed not closer than 2 cm above the sediment surface. The test is performed under continuous illumination.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compound (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: An experimental design is used consisting of exposure of test organisms to a number of test sediments, one or more reference sediments, and to the collection site control sediment. Each treatment consists of five replicate test chambers each containing 20 animals. Blind, random testing is used.

7.2 Preparation of Test Sediments: Test sediments are checked to be sure that the interstitial salinities are ≥ 25 ppt. If interstitial salinities are satisfactory, the sediments may be used without further treatment. For estuarine dredged material designated for ocean disposal, interstitial water salinities below 25 ppt (15 to 24 ppt) may be adjusted as specified in the Puget Sound protocols. If the sediments are not dredged material for ocean disposal and the interstitial water salinities are <25 ppt, the Eohaustorius estuarius bioassay should be used.

Each test sediment is mixed thoroughly using a non-contaminating implement, then an aliquot (175 ml) sufficient to make a 2-cm-deep layer is added to each test beaker, and the surface is smoothed. Bubbles are removed from the sediment by gently tapping each beaker against the palm of the hand. The sediment layer in each beaker is temporarily covered with a circular disc of plastic sheeting to protect the sediment layer during addition of seawater. Seawater at the test temperature and salinity is carefully poured into the beaker to the 750 ml mark, and the disc is then gently removed. The beakers are then placed into the water bath and covered with watchglasses. Constant illumination is provided by overhead lights. Water in the test beakers is aerated without disturbing the sediments. The test system is then allowed to temperature equilibrate overnight.

7.3 Beginning the Test: Amphipods are wet sieved, using a 0.5 mm sieve, from the holding sediment and impartially distributed to a series of containers each holding 20 amphipods. Enough amphipods are counted out at a time to add animals to one replicate set (e.g. replicate 1 of all test sediments, controls, etc.). Once amphipods are added to a replicate, animals that do not burrow into the test sediment within a few minutes are removed and replaced with healthy amphipods. Animals are added sequentially to the remaining replicates in the same manner. Following addition of amphipods to the test chambers, additional water is added to achieve a final volume of 950 ml.

7.4 Effects Criteria: Effect criteria are 1) mortality after 10 days, 2) daily emergence of amphipods from the test sediments, and 3) failure of amphipods to rebury in sediment at the end of the exposure period (optional for PSEP; required for PSDDA). Death is defined as no visible appendage movement or response to tactile stimulation.

7.5 Test Conditions: Test containers are maintained at a constant 15 ± 1°C. The test salinity is 28 ± 1 ppt. The dissolved oxygen concentration in each test container must be greater than 5 mg/L throughout the 10-day test. Each beaker is supplied with oil-free compressed air provided at a rate of approximately 100 bubbles per minute through disposable glass pipettes positioned with their tips approximately 2 cm above the sediment surface. Each beaker is covered by a glass watchglass to minimize evaporation and the possibility of cross contamination between beakers. Because phoxocephalid amphipods are known to migrate into the water column for the purposes of reproduction and dispersion under dark conditions, the test is conducted under constant illumination.

7.6 Feeding: Animals are not fed at any time before or during the test.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The duration of the sediment toxicity test is 10 days. The type and frequency of observations to be made are summarized as follows:

TYPE OF OBSERVATION	TIMES OF OBSERVATION
Biological Data	
Emergence from sediment	daily
Survival	end of test
Reburial (optional PSEP; required PSDDA)	end of test
Physical and Chemical Data	
Sediment interstitial salinity	at test beginning & end
Salinity, dissolved oxygen	at test beginning & end

pH, and temperature of overlying water (in all beakers)	
Salinity, dissolved oxygen, pH, and temperature of overlying water (1 repl. only)	daily (days 1 through 9)
Ammonia and sulfides in overlying water (optional, 1 repl.)	at test beginning & end
Temperature (in separate control beaker)	daily
Check air and lights	daily

The presence of amphipods that have emerged from the sediments is recorded daily. Any other unusual observations are recorded. No amphipods are removed at any time until the termination of the test. The bioassay is terminated after 10 days of sediment exposure. Floating or dead amphipods are recorded after which the sediment is wet sieved through a 0.5 mm screen to recover buried amphipods. The number of surviving amphipods is recorded. If the reburial endpoint is to be evaluated, surviving amphipods from each beaker are transferred to dishes containing a 2-cm layer of control sediment and observed under constant illumination. The numbers of amphipods able to bury after a 1-hour exposure period are then recorded.

Dissolved oxygen is measured directly in test beakers using a polarographic oxygen probe calibrated in air-saturated freshwater. The pH is measured using a properly calibrated pH meter with scale divisions of 0.1 pH units. Temperature is measured using a calibrated mercury thermometer or a telethermometer. Salinity is measured using a refractometer. Ammonia-N is measured using the HACH Model FF-3 test kit (ammonia-N detection limit 0.1 mg/L). Sulfide is measured using the HACH Hydrogen Sulfide Test Kit Model HS-WR (sulfide detection limit 0.01 mg/L). Any observed changes in sediment color or the formation of a sediment discontinuity layer is also recorded.

7.8 Criteria of Test Acceptance: For the test to be considered acceptable, the minimum survival of organisms in the control treatment at the end of the test must be 90%. Also, mortality in the reference sediments must be ≤20% over the negative control (optional).

8. DATA ANALYSIS

The mean and standard deviation are calculated for each endpoint employed (e.g. mortality) and for each treatment (i.e. test sediment). Between treatment comparisons may be made using a Student's t-test, Wilcoxon's Two-Sample test, or Mann-Whitney U test, where each treatment is compared to the control or the reference sediment. An arcsine-square root transformation of proportional data, and tests for normality and heterogeneity of variances, are performed prior to statistical comparisons. An estimate of total effective mortality (optional) may also be calculated by summing percent mortality and percent failure to rebury.

9. REPORTING

A report of the test results must include the following information: name and identification of the test; the investigator and laboratory; sediment holding temperature data; information on the test sediment including the interstitial salinity for control, reference and test sediments; information on the source of seawater used; detailed information about the test organisms including acclimation conditions; a description of the experimental design and test chambers and other test conditions including water quality; information about any aeration that may have been required; definition of the effects criteria and other observations; unusual responses, if any, in the control treatment; daily emergence for each beaker and the 10-day mean and S.D. for each treatment; failure to rebury for each beaker and the mean and S.D. for each treatment; 10-day mortality and total effective mortality (optional) in each beaker and the mean and S.D. for each treatment; 96-hr LC50 with reference toxicant; a description of data analysis methods employed and documentation of statistical test results; any unusual information about the test or deviations from procedures.

10. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect, and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

11. REFERENCED PROCEDURES

ASTM. 1992. Standard guide for conducting 10-day sediment toxicity tests with marine and estuarine amphipods. ASTM Standard Method No. E 1367-92. Am. Soc. Test. Mat., Philadelphia, PA.

Puget Sound Dredged Disposal Analysis (PSDDA). 1989. Management plan report - unconfined open-water disposal of dredged material, Phase II - (north and south Puget Sound). Puget Sound Dredged Disposal Analysis, Army Corps of Engineers, Seattle, WA.

Puget Sound Estuary Program. 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared for U.S. Env. Prot. Agency, Region 10, Office of Puget Sound, Seattle, WA and Puget Sound Water Quality Authority, P.O. Box 40900, Olympia, WA.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods. Sixth Ed., The Iowa State Univ. Press. Ames, Iowa., 593 pp.

Weber, C.I. (Ed.) 1991. Methods for measuring the acute toxicity of effluents to freshwater and marine organisms (Fourth Edition). EPA/600/4-90/027.

12. APPROVALS

_____ for _____
Name Date

_____ for NORTHWESTERN AQUATIC SCIENCES
Name Date

APPENDIX II

RAW DATA

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Rev'd pp 1-105

Test No. 590-1 Client Foster Wheeler Investigator [illegible] 7/22/98

STUDY MANAGEMENT

Client: Foster Wheeler Environmental, 10900 NE 8th St., Suite 1300, Bellevue, WA 98004

Client's Study Monitor: Gerg Braun

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Lab.

Laboratory's Study Personnel:

Proj. Man./Study Dir. R.S. Caldwell

QA Officer L.K. Nemeth

1. G.V. Irisarri G.J.I. 2. B.D. Crane BC 6. M.C. Redmond MLR

3. E. Coffey 4. Bridget Morris

5. Simon Islam

Study Schedule:

Test Beginning: 5-27-98 1:00 P Test Ending: 6-8-98 1:00 P

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	0690F	0691F	0692F	0721F	0722F
Description:	MWA5022RI	MWA5024RI	MWA5025RI	MWAT046RI	MWAT049RI
Collection Date:	5-15-98	5-15-98	5-15-98	5-18-98	5-18-98
Receipt Date:	5-18-98	5-18-98	5-18-98	5-20-98	5-20-98
Inters.Salinity (ppm):	28.5	27.0	28.0	27.0	28.0

NAS Sample No.:	0723F	0727F	0728F	0729F	~~0729~~ 0730F
Description:	MWAT051RI	MWAT054RI	MWAT043RI	MWAT048RI	MWAT052RI
Collection Date:	5-18-98	5-19-98	5-19-98	5-19-98	5-19-98
Receipt Date:	5-20-98	5-21-98	5-21-98	5-21-98	5-21-98
Inters.Salinity (ppm):	**	25.0	26.0	24.0 *	24.0 *

NAS Sample No.:	0749F	0750F	0751F	0748F	
Description:	MWRC208RI	MWRC209RI	MWRC210RI	CONTROL	
Collection Date:	5-22-98	5-22-98	5-22-98	~~5-25-98~~	5-25-98
Receipt Date:	5-23-98	5-23-98	5-23-98	5-27-98	
Inters.Salinity (ppm):	29.0	29.0	29.0	29.0	

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
Inters.Salinity (ppm):					

NAS Sample No.: * INTERSTITIAL SALINITIES ADJUSTED FOLLOWING

Description: PROCEDURES DESCRIBED IN PSEP MANUAL ~~APRIL 1997~~ JULY 1995

Collection Date:

Receipt Date: ** INSUFFICIENT WATER FOR SALINITY MEASUREMENT

Inters.Salinity (ppm):

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client FOSTER WHEELER Investigator

SEDIMENT DESCRIPTIONS--SUPLEMENTAL NOTES

Sample No.	Description
0748 F	black sand
0749 F	GRAY/GREEN, FINES AND LIGHT SAND, FEW DEAD WORMS
0750 F	gray/green, fines sand + silt, some dead worms, smell of death
0751 F	dark green, fine silt + sand
0729 F	DARK GRAY GREEN, FINES + SAND.
0690 F	Gray/brown sand, large rocks
0692 F	brown sand + mud, some rocks
0691 F	black sand w/ large rocks
0723 F	black sand, few dead worms
0728 F	DARK GRAY/GREEN, FINES & LIGHT SAND
0721 F	dark green/brown, finest rocks, sandy
0727 F	black/gray sand, pieces of wood, bivalves
0730 F	dark brown, sandy
0722 F	DARK GRAY/GREEN, SANDY

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

TEST ORGANISMS

Species: Rhepoxynius abronius Date Collected: 5-25-98

Source: West Beach Whidby Island WA

Field Conditions (interstitial) When Collected: Temp 11.0 Salinity 30.0

Acclimation Data:

Date	Temp (°C)	DO (mg/L)	pH	Sal (ppt)	Comments
5-27-98	7.8	2.6	7.1	30.0	rec. 5-27-98
5-28-98	15.9	6.7	7.3	30.0	
5-29-98	15.9	7.9	7.7	29.0	
Mean	13.2	5.7	7.4	29.7	
S.D.	4.7	2.8	0.3	0.6	
(N)	3	3	3	3	

TEST PROCEDURES AND CONDITIONS Covered with watchglasses.

Test chambers: 1 L glass beakers 950 ml

Test volumes: 175 ml of test sediment; ~~1300~~ ml total volume

* Replicates/treatment: (5) 5 Organisms/treatment: (100) 100

Test water changes: None Aeration: Yes, 3 cm below water surface

Feeding: None

Beaker placement: Total randomization

MISCELLANEOUS NOTES

* In addition 3 sacrificial beakers were set per sample. These were used to measure interstitial ammonia and sulfide on days Ø, 5, + 10. The latter was also utilized to measure WQ in overlying water.

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

Control Sediment: Collected from West Beach, Whidbey Island, WA 5-25-98

Randomization chart:

1	3	6	9	12	15	18	21	24	27	30
2	2	5	8	11	14	17	20	23	26	29
3	1	4	7	10	13	16	19	22	25	28
4										
5										

Randomization chart:

1	33	36	39	42	45	48	51	54	57	60
2	32	35	38	41	44	47	50	53	56	59
3	31	34	37	40	43	46	49	52	55	58
4										
5										

Randomization chart:

1	63	66	69	72	75	78	81	84	87	90
2	62	65	68	71	74	77	80	83	86	89
3	61	64	67	70	73	76	79	82	85	88
4										
5										

TEST WATER

Source: Yaquina Bay, OR

Date of Collection: 5-28-98 Salinity (ppt) 27.0 pH 7.5

Treatments: Aerated, Filtered to 0.4 µm

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

Control Sediment: West Beach, WA Amphipod Collection Site sediment

Randomization chart:

Bottom tray

1	93	96	99							
2	92	95	98							
3	91	94	97							
4										
5										

Randomization chart:

Top tray

1	102	105	108	111						
2	101	104	107	110						
3	100	103	106	109	112					
4										
5										

Randomization chart:

1										
2										
3										
4										
5										

TEST WATER

Source: Yaquina Bay OR

Date of Collection: 5-25-98 Salinity (ppt) _____ pH _____

Treatments: _____

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES — PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 0 (5/29/98) Temperature beaker 15.5 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10									All beakers
	2 S5									marked "S10" were
	3 S10									erroneously marked;
	4	15.5	8.0	28.0	7.8					they should have
	5 S10									been marked "S0"
WQ	6	15.0	8.0	27.0	7.8	<0.01	0.7			and were sacrificed
	7	15.4	8.0	28.0	7.8					on day 0 for measurement
	8	15.4	8.0	28.0	7.9					of initial chemistry.
	9	15.3	8.0	28.0	8.0					
	10 S5									
	11	15.4	8.1	28.0	8.0					
WQ	12	15.4	8.1	29.0	7.9	<0.01	2.1			
	13	15.5	8.1	28.0	7.7					
	14 S10									
	15	15.4	8.0	28.0	7.9					
	16	15.5	8.0	28.5	8.0					
	17	15.4	8.0	28.5	7.9					
	18	15.4	8.0	28.0	8.0					
	19	15.5	8.1	28.0	7.9					
WQ	20	15.4	8.0	27.0	8.0	<0.01	0.8			
WQ	21	15.5	8.0	28.0	8.0	<0.01	2.0			
	22	15.5	8.1	28.0	7.9					
	23	15.6	8.1	27.0	7.7					
	24	15.5	7.9	27.0	8.0					
	25	15.6	8.0	28.0	7.9					
	26	15.5	8.0	28.0	8.0					
	27 S10									
	28	15.6	8.1	28.0	8.0					
	29 S5									
	30	15.6	8.1	28.0	8.0					
WQ	31	15.6	8.1	28.0	8.0	<0.01	0.5			
	32	15.6	8.1	28.0	8.0					
	33 S5									
	34	15.7	8.0	27.0	7.9					
	35	15.5	8.1	27.0	8.0					
	36	15.4	8.1	28.0	8.0					
	37	15.5	8.1	27.0	8.0					
	38	15.5	8.0	28.0	8.0					
WQ	39	15.6	8.0	28.0	7.9	<0.01	1.2			
	40	15.6	8.1	28.0	7.9					
	41 S10									
	42	15.6	8.0	27.0	8.0					
	43	15.7	8.0	28.0	8.0					
	44 S10									
	45	15.7	8.0	28.5	7.9					
	46	15.7	8.0	28.0	7.9					
	47	15.6	7.8	28.0	7.9					

~~Amount Started~~

Conc.	Mean
10	[illegible]
3	[illegible]
1	[illegible]

7/22/98

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 0 (5/29/95) Form 85 ✱ Temperature beaker 15.5 °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48		15.7	7.9	28.0	7.9					
	49	SS									
✱ WQ	50		15.5	8.0	27.5	8.0	<0.01	1.3			
	51		15.5	8.0	28.0	8.1					
	52		15.6	8.1	28.0	8.1					
	53	SS									
	54		15.6	8.1	29.0	8.0					
	55		15.7	8.1	29.0	8.0					
	56		15.6	8.0	28.0	8.0					
	57	SS									
	58		15.6	8.0	28.0	8.0					
	59		15.5	8.0	28.0	8.0					
	60	SS									
WQ	61		15.7	8.1	28.0	8.0	<0.01	2.3			
	62		15.5	8.0	28.5	8.0					
	63		15.5	8.1	27.5	8.0					
	64		15.7	8.1	28.0	8.0					
	65		15.5	8.0	27.0	8.1					
WQ	66		15.5	8.0	27.0	8.1	<0.01	1.4			
	67		15.7	8.1	27.0	8.0					
	68	S10									
	69		15.6	8.2	28.0	8.0					
	70	SS									
	71		15.5	8.1	28.0	8.0					
WQ	72		15.5	8.1	29.0	8.0	<0.01	1.0			
	73		15.7	7.6	28.0	7.9					
	74	S10									
	75		15.3	8.0	28.0	8.1					
	76		15.6	7.2	28.0	7.7					
WQ	77		15.4	8.0	28.0	8.1	<0.01	1.4			
	78		15.6	8.1	27.0	7.9					
	79		15.5	8.1	27.0	8.1					
	80		15.4	8.1	28.0	8.2					
	81	SS									
	82	S10									
	83	SS									
	84		15.4	8.2	27.0	8.0					
	85		15.6	8.2	28.0	8.1					
	86		15.6	8.0	28.0	7.9					
	87	S10									
	88		15.6	7.8	28.0	8.0					
	89		15.4	8.0	28.0	8.0					
	90	S10									
WQ	91		15.7	7.2	28.0	7.9	<0.01	1.0			
	92		15.5	7.9	28.0	8.0					
	93		15.3	8.1	28.0	8.1					
	94		15.6	7.8	29.0	8.1					

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 0 (5/29/98) Brm KS Temperature beaker 15.5 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS									
	96	15.5	8.0	28.0	8.1					
	97	15.7	8.1	28.0	8.0					
	98	15.5	8.0	28.0	8.0					
	99	15.4	8.0	28.0	8.1					
	100	15.8	7.3	28.0	7.9					
	101 S10									
	102	15.7	7.6	28.0	7.8					
WQ	103	15.8	7.8	28.0	8.0	<0.01	0.6			
	104 SS									
WQ	105	15.7	8.0	28.0	8.0	<0.01	0.3			
	106	15.5	8.0	29.0	8.0					
	107	15.7	7.9	28.0	8.0					
	108 S10									
	109	15.5	8.0	28.0	8.1					
	110	15.6	7.8	28.0	8.0					
	111 SS									
	112	15.8	7.8	29.0	8.0					

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 1 (5/13/98) Wed Temperature beaker 15.3 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								ALL	
	2 S5								OK	
	3 S10									
	4							0		
	5 S10									
WQ	6	15.2	8.0	28.0	7.3			1		
	7							2		
	8							0		
	9							0		
	10 S5									
	11							0		
WQ	12	15.0	8.0	28.0	7.7			0		
	13							0		
	14 S10									
	15							0		
	16							0		
	17							0		
	18							0		
	19							0		
WQ	20	15.0	8.0	28.0	7.8			0		
WQ	21	14.9	8.1	28.0	7.8			0		
	22							0		
	23							0		
	24							0		
	25							1		
	26							1		
	27 S10									
	28							0		
	29 S5									
	30							0		
WQ	31	15.0	8.0	28.0	7.8			0		
	32							1		
	33 S5									
	34							0		
	35							0		
	36							0		
	37							0		
	38							0		
WQ	39	14.9	8.0	28.0	7.9			0		
	40							0		
	41 S10									
	42							0		
	43							1		
	44 S10									
	45							0		
	46							0		
	47							1		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 1 (5/30/96) Temperature beaker 15.0 °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48								0	ALL	
	49	SS								OK	
WQ	50		14.9	8.0	28.0	7.9			0		
	51								0		
	52								0		
	53	SS									
	54								0		
	55								0		
	56								1		
	57	SS									
	58								0		
	59								0		
	60	SS									
WQ	61		15.0	8.1	28.0	7.9			0		
	62								0		
	63								0		
	64								0		
	65								0		
WQ	66		14.8	8.1	28.0	8.0			0		
	67								0		
	68	S10									
	69								0		
	70	SS									
	71								0		
WQ	72		14.9	8.0	28.0	8.0			0		
	73								0		
	74	S10									
	75								0		
	76								0		
WQ	77		14.9	8.0	28.5	8.1			0		
	78								0		
	79								0		
	80								0		
	81	SS									
	82	S10									
	83	SS									
	84								0		
	85								0		
	86								0		
	87	S10									
	88								0		
	89								0		
	90	S10									
WQ	91		14.9	8.0	28.0	8.0			0		
	92								0		
	93								0		
	94								0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 1 (5/30/98) Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								ALL	
	96							0	OK	
	97							0		
	98							0		
	99							0		
	100							0		
	101 SID									
	102							1		
WQ	103	15.1	8.1	28.0	8.0			1		
	104 SS									
WQ	105	15.0	8.1	28.0	7.9			0		
	106							0		
	107							0		
	108 SID									
	109							0		
	110							0		
	111 SS									
	112							0		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 2 (5/31/95) Temperature beaker 15.0 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 SIO								OK	
	2 SS									During purge of Air line, some water got into line, causing some aerators to stop.
	3 SIO									
	4							0		
	5 SIO									
WQ	6	15.0	7.5	27.0	7.3			0		
	7							1		
	8							0		
	9							0		
	10 SS									
	11							0		
WQ	12	14.9	7.8	27.0	7.7			1		
	13							2		
	14 SIO									
	15							0		
	16							0		
	17							0		
	18							0		
	19							0		
WQ	20	15.0	7.8	27.0	7.7			1		
WQ	21	15.0	7.8	27.0	7.9			0		
	22							0		
	23							0		
	24							0		
	25							0		
	26							0		
	27 SIO									
	28							0		
	29 SS									
	30							0		
WQ	31	15.0	7.7	27.0	7.9			0		
	32							0		
	33 SS									
	34							1		
	35							0		
	36							0	✓	
	37		7.8					0	Off	Reestablished
	38		7.8					0		"
WQ	39	15.0	7.7	27.0	8.0			0		"
	40		7.8					0		"
	41 SIO									"
	42		7.7					0		"
	43		7.8					0		"
	44 SIO									"
	45		7.6					0		"
	46		7.5					0		"
	47		7.8					1		"

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 2 (5/31/93) M Temperature beaker 15.0 °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48			7.8					O	off	Reestablished
	49	SS									"
WQ	50		15.0	7.4	27.0	7.8			O		"
	51			7.6					O		"
	52			7.8					O		"
	53	SS									"
	54			7.8					O		"
	55			7.5					I		"
	56								C	ok	
	57	SS									
	58								I		
	59								C		
	60	SS									
WQ	61		15.1	7.5	27.0	7.4			O		
	62								C		
	63								C		
	64								I		
	65								O		
WQ	66		15.0	7.7	26.5	8.0			C		
	67								C		
	68	S10									
	69								C		
	70	SS									
	71								O		
WQ	72		15.0	7.5	28.0	8.0			C		
	73			7.6					C	off	Reestablished
	74	S10								ok	
	75								C		
	76								C		
WQ	77		14.9	7.7	28.0	8.1			C		
	78								C		
	79								C		
	80								C		
	81	SS									
	82	S10									
	83	SS									
	84								C		
	85								C		
	86								C		
	87	S10									
	88								C		
	89								C		
	90	S10									
WQ	91		15.0	7.5	27.5	8.0			C		
	92								C		
	93								C		
	94								C		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 2 (5/31/98) Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								OK	
	96							0		
	97							0		
	98							0		
	99							0		
	100		7.6					0	off	Reestablished
	101 SIO									"
	102		7.8					0		"
WQ	103	15.1	7.6	28.0	7.7			0		"
	104 SS									"
WQ	105	15.0	7.2	28.0	7.7			0		"
	106		7.4					0		"
	107		7.8					0		"
	108 SIO									"
	109		7.8					0		"
	110		7.5					0		"
	111 SS									"
	112		7.5					0		"

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 3 (8/01/98) 885/6n Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								OK	
	2 S5									
	3 S10									
	4							0		
	5 S10									
WQ	6	15.1	7.9	27.5	7.6			0		
	7							0		
	8							0		
	9							0		
	10 S5									
	11							0		
WQ	12	15.0	7.8	27.5	7.9			0		
	13							1		
	14 S10									
	15							0		
	16							1		
	17							0		
	18							0		
	19							0		
WQ	20	15.1	7.9	27.0	7.8			1		
WQ	21	15.1	7.9	27.0	7.9			0		
	22							0		
	23							0		
	24							0		
	25							0		
	26							0		
	27 S10									
	28							0		
	29 S5									
	30							0		
WQ	31	15.1	8.0	27.5	7.9			0		
	32							0		
	33 S5									
	34							0		
	35							0		
	36							0		
	37							0		
	38							0		
WQ	39	15.2	8.0	27.0	7.0			0		
	40							0		
	41 S10									
	42							0		
	43							0		
	44 S10									
	45							0		
	46							0		
	47							0		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 3 (6/01/98) CB/m Temperature beaker 15.1 °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48									OK	
	49	SS									
WQ	50		15.1	7.9	27.0	7.7			C		
	51								C		
	52								2		
	53	SS									
	54								1		
	55								C		
	56								C		
	57	SS									
	58								1		
	59								C		
	60	SS									
WQ	61		15.2	7.7	27.5	8.0			C		
	62								C		
	63								1		
	64								1		
	65								C		
WQ	66		15.3	7.8	27.0	8.0			C		
	67								C		
	68	S10									
	69								C		
	70	SS									
	71								C		
WQ	72		15.2	7.9	28.5	7.9			C		
	73								1		
	74	S10									
	75								1		
	76								1		
WQ	77		15.1	8.0	26.0	8.1			C		
	78								C		
	79								C		
	80								C		
	81	SS									
	82	S10									
	83	SS									
	84								1		
	85								C		
	86								C		
	87	S10									
	88								C		
	89								C		
	90	S10									
WQ	91		15.1	8.0	28.5	8.1					
	92								1		
	93								C		
	94								1		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 3 (6/01/98) c-3/4n Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								CK	
	96							0		
	97							0		
	98							0		
	99							0		
	100							0		
	101 SID									
	102							0		
WQ	103	15.2	8.0	29.0	8.0			1		
	104 SS									
WQ	105	15.1	8.0	29.0	8.1			0		
	106							0		
	107							0		
	108 SID									
	109							0		
	110							0		
	111 SS									
	112							2		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 4 (6/2/98) 85/BC Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								OK	
	2 S5									
	3 S10									
	4							1		
	5 S10									
WQ	6	15.0	7.8	27.0	7.7			0		
	7							2		
	8							0		
	9							1		
	10 S5									
	11							1		
WQ	12	15.0	7.7	27.0	8.0			0		
	13							0		
	14 S10									
	15							0		
	16							1		
	17							0		
	18							0		
	19							0		
WQ	20	15.1	7.8	27.0	8.0			0		
WQ	21	15.0	7.9	28.0	8.1			0		
	22							1		
	23							0		
	24							0		
	25							0		
	26							0		
	27 S10									
	28							0		
	29 S5									
	30							1		
WQ	31	15.2	8.0	28.0	8.1			0		
	32							2		
	33 S5									
	34							0		
	35							0		
	36							0		
	37							0		
	38							0		
WQ	39	15.1	8.0	28.0				0		
	40							0		
	41 S10									
	42							0		
	43							0		
	44 S10									
	45							0		
	46							0		
	47									

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 4 (6/2/98) 95 Temperature beaker °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48								1	OK	
	49	SS									
WQ	50		15.1	7.9	27.0				1		
	51								0		
	52								2		
	53	SS									
	54								C		
	55								C		
	56								1		
	57	SS									
	58								C		
	59								1		
	60	SS									
WQ	61		15.2	8.0	27.0	8.1			C		
	62								C		
	63								C		
	64								C		
	65								C		
WQ	66		15.2	8.0	27.0	8.1			1		
	67								C		
	68	S10									
	69								C		
	70	SS									
	71								2		
WQ	72		15.2	8.0	27.0	8.1			1		
	73								1		
	74	S10									
	75								1		
	76								C		
WQ	77		15.1	8.0	26.0	8.2			C		
	78								C		
	79								C		
	80								C		
	81	SS									
	82	S10									
	83	SS									
	84								C		
	85								1		
	86								C		
	87	S10									
	88								C		
	89								C		
	90	S10									
WQ	91		15.2	8.0	25.0	8.0			C		
	92								2		
	93								C		
	94								1		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 4 (6/2/93) Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								ok	
	96							0		
	97							1		
	98							0		
	99							1		
	100							0		
	101 SID									
	102							0		
WQ	103	15.3	7.7	29.0	7.9			0		
	104 SS									
WQ	105	15.0	7.6	29.0	8.1			0		
	106							0		
	107							0		
	108 SID									
	109							0		
	110							0		
	111 SS									
	112							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 5 (6/13/98) M/BC Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								ALL	
	2 S5								OK	
	3 S10									
	~~4~~	~~15.0~~			~~7.4~~			1		
	5 S10									
WQ	6	15.0	8.2	27.0	7.4			0		
	7							0		
	8							0		
	9							0		
	10 S5									
	11							0		
WQ	12	15.0	8.2	27.0	7.9			0		
	13							1		
	14 S10									
	15							0		
	16							0		
	17							0		
	18							0		
	19							1		
WQ	20	15.0	8.1	27.0	7.8			0		
WQ	21	15.0	8.2	27.0	7.9			0		
	22							1		
	23							1		
	24							0		
	25							0		
	26							0		
	27 S10									
	28							0		
	29 S5									
	30							0		
WQ	31	15.1	8.2	27.0	8.0			0		
	32							0		
	33 S5									
	34							1		
	35							0		
	36							0		
	37							0		
	38							0		
WQ	39	15.0	8.2	27.0	8.1			0		
	40							0		
	41 S10									
	42							0		
	43							0		
	44 S10									
	45							0		
	46							0		
	47							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 5 (6/29/98) 1m/8 Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48							1	ALL	
	49	SS							OK	
WQ	50	15.1	8.3	27.0	7.8			0		
	51							0		
	52							0		
	53	SS								
	54							0		
	55							1		
	56							0		
	57	SS								
	58							1		
	59							0		
	60	SS								
WQ	61	15.2	8.1	27.0	8.0			0		
	62							0		
	63							0		
	64							0		
	65							0		
WQ	66	15.1	8.0	27.0	8.1			0		
	67							0		
	68	S10								
	69							0		
	70	SS								
	71							0		
WQ	72	15.1	8.2	28.5	8.0			0		
	73							0		
	74	S10								
	75							0		
	76							0		
WQ	77	15.1	8.2	28.0	8.1			0		
	78							0		
	79							0		
	80							0		
	81	SS								
	82	S10								
	83	SS								
	84							0		
	85							0		
	86							0		
	87	S10								
	88							0		
	89							0		
	90	S10								
WQ	91	15.1	8.2	28.0	8.0			0		
	92							0		
	93							0		
	94							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 5 (6/3/96) Kr/sc Temperature beaker 15.1 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								AL	
	96							0	OK	
	97							1		
	98							0		
	99							0		
	100							0		
	101 SIO									
	102							0		
WQ	103	15.2	8.2	29.0	7.8			0		
	104 SS									
WQ	105	15.0	8.0	29.0	8.0			0		
	106							0		
	107							0		
	108 SIO									
	109							0		
	110							0		
	111 SS									
	112							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 6 (6/14/98) 98/12 Temperature beaker 15.2 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								OK	
	2 SS									
	3 S10									
	4							0		
	5 S10									
WQ	6	15.1	7.6	28.5	7.7			0		
	7							0		
	8							0		
	9							0		
	10 SS									
	11							0		
WQ	12	15.1	7.6	28.5	8.1			0		
	13							0		
	14 S10									
	15							0		
	16							1		
	17							0		
	18							0		
	19							0		
WQ	20	15.1	7.[illegible]	29.0	8.0			0		
WQ	21	15.1	7.[illegible]	27.0	8.0			0		
	22							2		
	23							0		
	24							0		
	25							0		
	26							0		
	27 S10									
	28							0		
	29 SS									
	30							0		
WQ	31	15.2	7.[illegible]	29.0	8.1			0		
	32							0		
	33 SS									
	34							[illegible]		
	35							0		
	36							0		
	37							[illegible]		
	38							[illegible]		
WQ	39	15.2	7.[illegible]	28.5	8.2			[illegible]		
	40							0		
	41 S10									
	42							0		
	43							[illegible]		
	44 S10									
	45							0		
	46							0		
	47							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 6 (6/14/98)-25/n Temperature beaker 15.2°C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48								1	OK	
	49	SS									
WQ	50		15.2	7.8	29.0	7.9			0		
	51								0		
	52								0		
	53	SS									
	54								0		
	55								0		
	56								0		
	57	SS									
	58								0		
	59								0		
	60	SS									
WQ	61		15.3	7.7	29.0	8.1			0		
	62								0		
	63								0		
	64								0		
	65								0		
WQ	66		15.3	7.7	29.0	8.1			0		
	67								0		
	68	S10									
	69										
	70	SS									
	71								0		
WQ	72		15.3		29.0	8.0			0		
	73								0		
	74	S10									
	75								0		
	76								1		
WQ	77		15.3		28.0	8.1			0		
	78								0		
	79								0		
	80								0		
	81	SS									
	82	S10									
	83	SS									
	84								0		
	85								0		
	86								0		
	87	S10									
	88								0		
	89								0		
	90	S10									
WQ	91		15.2		29.0	8.0			1		
	92								0		
	93								0		
	94								0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 6 (6/14/98) 8/M Temperature beaker 15.2°C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								OK	
	96							0		
	97							0		
	98							0		
	99							0		
	100							0		
	101 S10									
	102							0		
WQ	103	15.3	5.0	24.0	7.8			0		
	104 SS									
WQ	105	15.2	7.7	24.0	8.1			0		
	106							0		
	107							0		
	108 S10									
	109							0		
	110							0		
	111 SS									
	112							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 7 (6/5/96) BC Temperature beaker 15.2 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								OK	
	2 SS									
	3 S10									
	4							0		
	5 S10									
WQ	6	15.2	7.6	[illegible]	7.8			0		
	7							1		
	8							1		
	9							0		
	10 SS									
	11							1		
WQ	12	15.2	7.8	[illegible]	8.2			0		
	13							0		
	14 S10									
	15							0		
	16							2		
	17							0		
	18							0		
	19							1		
WQ	20	15.1	7.8	[illegible]	8.1			1		
WQ	21	15.1	7.8	[illegible]	8.1			1		
	22							1		
	23							0		
	24							0		
	25							0		
	26							1		
	27 S10									
	28							0		
	29 SS									
	30							0		
WQ	31	15.1	7.8	27.0	8.2			1		
	32							2		
	33 SS									
	34							0		
	35							0		
	36							0		
	37							0		
	38							0		
WQ	39	15.1	7.8	27.0	8.2			0		
	40							0		
	41 S10									
	42							0		
	43							0		
	44 S10									
	45							0		
	46							0		
	47							0		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 7 (6/5/98) BC Temperature beaker 15 °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48								2	Ok	
	49	SS									
WQ	50		15.2	7.8	27.0	7.9			0		
	51								1		
	52								0		
	53	SS									
	54								0		
	55								4		
	56								0		
	57	SS									
	58								1		
	59								1		
	60	SS									
WQ	61		15.1	7.8	27.0	8.1			1		
	62								0		
	63								0		
	64								0		
	65								0		
WQ	66		15.1	7.8	27.0	8.1			0		
	67								0		
	68	S10									
	69								0		
	70	SS									
	71								0		
WQ	72		15.1	7.8	27.0	8.1			0		
	73								1		
	74	S10									
	75								1		
	76								0		
WQ	77		15.1	7.8	27.0	8.2			0		
	78								0		
	79								0		
	80								0		
	81	SS									
	82	S10									
	83	SS									
	84								4		
	85								0		
	86								2		
	87	S10									
	88								0		
	89								0		
	90	S10									
WQ	91		15.1	7.8	27.0	8.1			3		
	92								5		
	93								2		
	94								0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 7 (6/15/98) BC Temperature beaker _____ °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								ok	
	96							1		
	97							2		
	98							0		
	99							2		
	100							0		
	101 SIO									
	102							0		
WQ	103	15.1	7.6	29.0	7.8			1		
	104 SS									
WQ	105	15.1	7.6	29.0	8.1			0		
	106							0		
	107							0		
	108 SIO									
	109							0		
	110							0		
	111 SS									
	112							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 8 (6/5/96) Temperature beaker 15.0 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								OK	
	2 SS									
	3 S10									
	4							1		
	5 S10									
WQ	6	15.1	8.0	28.0	7.7			0		
	7							0		
	8							2		
	9							0		
	10 SS									
	11							1		
WQ	12	15.1	7.9	28.0	8.0			0		
	13							0		
	14 S10									
	15							0		
	16							3		
	17							1		
	18							1		
	19							0		
WQ	20	15.1	7.9	28.0	8.1			0		
WQ	21	15.1	7.9	28.0	8.1			0		
	22							1		
	23							0		
	24							0		
	25							1		
	26							0		
	27 S10									
	28							0		
	29 SS									
	30							0		
WQ	31	15.1	8.0	28.0	8.0			0		
	32							2		
	33 SS									
	34							0		
	35							0		
	36							0		
	37							0		
	38							0		
WQ	39	15.1	8.2	27.0	8.2			0		
	40							0		
	41 S10									
	42							0		
	43							0		
	44 S10									
	45							0		
	46							0		
	47							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 8 (6/15/93) BC Temperature beaker _____ °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48								3	OK	
	49	SS									
WQ	50		15.0	8.0	27.0	7.9			0		
	51								0		
	52								2		
	52	SS									
	54								0		
	55								1		
	56								1		
	57	SS									
	58										
	59								0		
	60	SS									
WQ	61		15.1	8.0	27.0	8.1			1		
	62								0		
	63								0		
	64								1		
	65								1		
WQ	66		15.1	8.0	27.0	8.2			0		
	67								0		
	68	S10									
	69								0		
	70	SS									
	71								0		
WQ	72		15.1	8.0	27.0	8.0			0		
	73								0		
	74	S10									
	75								0		
	76								0		
WQ	77		15.1	8.0	25.0	8.2			0		
	78								0		
	79								0		
	80								0		
	81	SS									
	82	S10									
	83	SS									
	84								2		
	85								0		
	86								2		
	87	S10									
	88								0		
	89								2		
	90	S10									
WQ	91		15.1	8.1	26.0	8.1			0		
	92								0		
	93								2		
	94								0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 7 (6/15/98) BC Temperature beaker _____ °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								OK	
	96							0		
	97							2		
	98							0		
	99							0		
	100							1		
	101 SID									
	102							0		
WQ	103	15.1	8.1	29.0	7.9			1		
	104 SS									
WQ	105	15.1	8.1	25.0	8.0			0		
	106			x BC				0		
	107							1		
	108 SID									
	109							0		
	110							1		
	111 SS									
	112							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 9 (6/16/98) BC Temperature beaker 15.0 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								OK	
	2 SS									
	3 S10									
	4							1		
	5 S10									
WQ	6	15.0	8.0	29.0	7.7			0		
	7							0		
	8							0		
	9							0		
	10 SS									
	11							1		
WQ	12	15.0	8.0	29.0	8.2			1		
	13							0		
	14 S10									
	15							0		
	16							2		
	17							2		
	18							0		
	19							0		
WQ	20	15.0	8.0	28.0	8.1			2		
WQ	21	15.0	8.0	28.0	8.1			1		
	22							1		
	23							0		
	24							0		
	25							0		
	26							0		
	27 S10									
	28							0		
	29 SS									
	30							1		
WQ	31	15.0	8.0	28.0	8.2			2		
	32							2		
	33 SS									
	34							0		
	35							0		
	36							0		
	37							2		
	38							1		
WQ	39	15.0	8.0	28.0	8.2			0		
	40							0		
	41 S10									
	42							0		
	43							1		
	44 S10									
	45							0		
	46							0		
	47							0		

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MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 9 (6/16/98) BC Temperature beaker _____ °C

	Beaker No.		Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48								2	OK	
	49	SS									
WQ	50		15.0	8.0	27.0	8.0			0		
	51								1		
	52								0		
	53	SS									
	54								0		
	55								0		
	56								0		
	57	SS									
	58								0		
	59								1		
	60	SS									
WQ	61		15.1	8.0	27.0	8.1			0		
	62								0		
	63								0		
	64								1		
	65								0		
WQ	66		15.1	8.0	28.0	8.2			2		
	67								0		
	68	S10									
	69								2		
	70	SS									
	71								0		
WQ	72		15.1	8.0	28.0	8.1			0		
	73								1		
	74	S10									
	75								0		
	76								0		
WQ	77		15.1	8.0	28.0	8.0			2		
	78								0		
	79								2		
	80								0		
	81	SS									
	82	S10									
	83	SS									
	84								2		
	85								0		
	86								0		
	87	S10									
	88								0		
	89								0		
	90	S10									
WQ	91		15.1	8.0	28.0	8.1			1		
	92								4		
	93								2		
	94								1		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator _____

DAILY RECORD SHEET

Day 9 (6/6/98) Temperature beaker _____ °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								OK	
	96							0		
	97							1		
	98							2		
	99							0		
	100							0		
	101 SIO									
	102							0		
WQ	103	15.1	8.0	29.0	7.9			1		
	104 SS									
WQ	105	15.1	8.0	29.0	8.1			0		
	106							0		
	107							0		
	108 SIO									
	109							0		
	110							0		
	111 SS									
	112							0		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 10 (6/17/98) [illegible] Temperature beaker 15.0 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	1 S10								GK	
	2 S5									
	3 S10									
	4	15.3	7.7	29.0	7.9			0		
	5 S10									
WQ	6	15.2	7.3	28.0	7.8	<0.01	1.1	1		
	7	15.2	7.4	28.5	7.7			2		
	8	15.1	7.4	29.0	7.7			1		
	9	15.0	7.6	29.0	8.1			0		
	10 S5									
	11	15.0	7.7	29.0	8.1			1		
WQ	12	15.0	7.7	29.0	8.2	<0.01	0.2	0		
	13	15.0	7.7	28.0	8.0			2		
	14 S10									
	15	15.0	7.5	28.0	8.2			0		
	16	15.0	7.6	28.0	8.2			3		
	17	15.0	7.6	28.0	7.9			1		
	18	15.0	7.7	28.0	8.0			0		
	19	15.0	7.7	28.0	8.2			2		
WQ	20	15.0	7.6	28.0	8.1	<0.01	<0.2	1		
WQ	21	15.0	7.7	28.0	8.1	<0.01	0.2	1		
	22	15.0	7.7	28.0	8.0			1		
	23	15.0	7.7	28.0	8.0			0		
	24	15.0	7.7	28.0	8.2			0		
	25	15.0	7.7	29.0	8.1			0		
	26	15.0	7.7	28.0	8.2			0		
	27 S10									
	28	14.9	7.8	29.0	8.0			1		
	29 S5									
	30	14.9	7.8	29.0	7.9			0		
WQ	31	15.0	7.8	28.5	8.3	<0.01	0.4	0		
	32	15.0	7.7	29.0	8.2			2		
	33 S5									
	34	15.0	7.8	28.0	8.1			2		
	35	15.0	7.7	29.0	8.3			0		
	36	14.9	7.7	29.0	8.1			0		
	37	14.9	7.8	29.0	8.1			1		
	38	15.0	7.8	28.0	7.9			1		
WQ	39	14.9	7.8	29.0	8.3	<0.01	0.5	3		
	40	14.9	7.8	29.0	8.2			0		
	41 S10									
	42	15.0	7.8	29.0	8.4			1		
	43	14.7	7.9	28.0	8.0			1		
	44 S10									
	45	15.0	7.9	28.0	8.0			0		
	46	14.9	7.8	28.0	8.2			0		
	47	15.0	7.8	28.0	8.3			4		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 10 (6/7/98) Am/BC Temperature beaker 15.0 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	48	15.0	7.8	29.0	8.4			2	OK	
	49 SS									
WQ	50	15.0	7.8	28.0	8.1	<0.01	1.7	0		
	51	15.0	7.6	29.0	8.1			1		
	52	15.0	7.6	29.0	8.3			1		
	53 SS									
	54	15.0	7.7	28.0	8.2			2		
	55	15.0	7.8	29.0	8.3			0		
	56	15.0	7.7	28.0	8.3			0		
	57 SS									
	58	15.0	7.6	29.0	8.0			1		
	59	15.0	7.7	28.0	8.0			1		
	60 SS									
WQ	61	15.1	7.8	28.0	8.3	<0.01	~~1.7~~ 2.6	0		
	62	15.0	7.7	29.0	8.2			0		
	63	15.0	7.8	29.0	8.0			2		
	64	15.0	7.8	30.0	8.3			0		
	65	15.0	7.7	28.0	8.2			0		
WQ	66	15.0	7.6	28.0	8.2	<0.01	~~<0.1~~ 1.7	1		
	67	15.0	7.7	29.0	8.2			0		
	68 SS10									
	69	15.0	7.8	29.0	8.3			2		
	70 SS									
	71	15.0	7.8	29.0	8.1			0		
WQ	72	15.1	7.8	29.0	8.1	<0.01	<0.2	0		
	73	15.0	7.8	29.0	8.4			1		
	74 SS10									
	75	15.1	7.7	28.0	8.3			1		
	76	15.1	7.7	29.0	8.1			1		
WQ	77	15.0	7.6	29.0	8.3	<0.01	1.3	1		
	78	15.0	7.6	28.0	8.2			2		
	79	15.0	7.5	28.0	8.2			2		
	80	15.0	7.6	29.0	8.4			0		
	81 SS									
	82 SS10									
	83 SS									
	84	15.0	7.7	29.0	8.2			3		
	85	15.0	7.9	29.0	8.3			2		
	86	15.0	7.8	29.0	8.3			0		
	87 SS10									
	88	15.0	7.9	30.0	8.2			0		
	89	15.0	7.8	30.0	8.0			0		
	90 SS10									
WQ	91	15.0	7.8	29.0	8.0	<0.01	<0.2	1		
	92	15.0	7.8	29.0	8.3			1		
	93	15.0	7.8	29.0	8.4			3		
	94	15.0	7.8	29.0	8.4			0		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAILY RECORD SHEET

Day 10 (6/7/98) BM / BC Temperature beaker 15.0 °C

	Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	No. Emerged	Air	Comments
	95 SS								OK	
	96	15.1	7.8	29.0	8.3			3		
	97	15.0	7.8	29.0	8.1			2		
	98	15.1	7.8	29.0	8.1			1		
	99	15.0	7.8	29.0	8.3			1		
	100	15.1	8.0	29.0	8.7			2		
	101 SID									
	102	15.0	8.0	29.0	8.4			0		
WQ	103	15.0	7.7	29.0	7.9	<0.01	0.6	0		
	104 SS									
WQ	105	15.0	7.6	29.0	8.1	<0.01	<0.2	0		
	106	14.9	8.1	29.0	8.7			1		
	107	15.1	8.2	29.0	8.6			1		
	108 SID									
	109	15.1	8.2	29.0	8.5			0		
	110	15.1	8.1	29.0	8.2			2		
	111 SS									
	112	15.1	8.1	29.0	8.6			0		

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAY 10 TEST TERMINATION SHEET

	Beaker No.	Interstitial salinity (ppt)	Number of survivors	Number Reburied	Initial
	1	—	—	—	—
	2	—	—	—	—
	3	—	—	—	—
	4	29.5	19	19	BC
	5	—	—	—	—
WQ	6	29.5	—	—	—
	7	29.0	19	18	Bm
	8	29.5	17	17	BC
	9	29.5	18	18	BC
	10	30	—	—	—
	11	30.0	19	19	GJI
WQ	12	29.5	—	—	—
	13	29.5	20	18	Bm
	14	—	—	—	—
	15	29.0	20	20	BC
	16	28.0	18	19	GJI
	17	29.0	19	18	BC
	18	28.0	20	20	Bm
	19	29.5	20	20	GJI
WQ	20	29.5	—	—	—
WQ	21	29.5	—	—	—
	22	29.0	20	20	GJI
	23	28.0	19	19	BC
	24	29.0	20	20	GJI
	25	28.0	19	19	Bm
	26	29.5	18	18	GJI
	27	—	—	—	—
	28	29.5	19	19	Bm
	29	—	—	—	—
	30	29.5	19	18	BC
WQ	31	29.5	—	—	—
	32	29.5	19	19	GJI
	33	—	—	—	—
	34	28.5	19	19	GJI
	35	29.5	20	20	BC
	36	29.5	20	19	Bm
	37	29.0	20	19	GJI
	38	30.0	19	19	BC
WQ	39	29.5	—	—	—
	40	30.0	19	19	Bm
	41	—	—	—	—
	42	28.0	18	19	GJI
	43	28.0	18	17	BC
	44	—	—	—	—
	45	27.5	20	20	Bm
	46	27.5	19	19	GJI
	47	27.0	17	17	BC
	48	27.0	19	19	GJI

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Foster Wheeler Investigator

DAY 10 TEST TERMINATION SHEET

	Beaker No.	Interstitial salinity (ppt)	Number of survivors	Number Reburied	Initial
	49	—	—	—	—
WQ	50	29.5	—	—	—
	51	28.0	19	19	BM
	52	~~28~~ 28.0	18	18	BC
	53	—	—	—	—
	54	27.0	18	18	GJL
	55	27.0	17	17	BC
	56	27.0	19	18	BM
	57	—	—	—	—
	58	27.5	18	18	GJL
	59	27.0	20	20	BC
	60	—	—	—	—
WQ	61	29.5	—	—	—
	62	27.0	20	20	GJL
	63	28.0	19	19	BM
	64	28.0	17	17	BC
	65	28.0	20	19	GJL
WQ	66	28.0	—	—	—
	67	27.0	19	19	BM
	68	—	—	—	—
	69	28.0	14	14	BC
	70	8.W	—	—	—
	71	28.5	18	18	GJL
WQ	72	28.0	—	—	—
	73	29.0	19	18	BM
	74	—	—	—	—
	75	27.0	18	18	GJL
	76	28.5	19	19	BC
WQ	77	28.0	—	—	—
	78	27.0	20	19	BM
	79	28.0	19	18	GJL
	80	28.0	20	19	BC
	81	—	—	—	—
	82	—	—	—	—
	83	—	—	—	—
	84	27.0	19	19	BC
	85	27.0	19	19	GJL
	86	28.0	16	16	BM
	87	—	—	—	—
	88	27.0	16	15	BC
	89	27.0	17	17	GJL
	90	—	—	—	—
WQ	91	28.0	—	—	—
	92	27.0	16	14	GJL
	93	27.0	19	19	BC
	94	27.0	20	20	BM
	95	~~[illegible]~~	—	—	—
	96	28.0	20	20	GJL

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

MARINE AMPHIPOD 10-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-1 Client Esther Wheeler Investigator

DAY 10 TEST TERMINATION SHEET

Beaker No.	Interstitial salinity (ppt)	Number of survivors	Number Reburied	Initial
97	27.5	20	20	Bm
98	28.5	18	17	GJL
99	27.0	16	16	Bc
100	27.5	18	18	GJL
101	—	—	—	—
102	29.0	18	17	Bm
WQ 103	29.0	—	—	—
104	—	—	—	—
WQ 105	29.0	—	—	—
106	29.0	18	18	Bc
107	29.5	19	19	GJL
108	—	—	—	—
109	28.0	20	19	Bm
110	27.0	16	16	GJL
111	—	—	—	—
112	29.0	20	20	Bm

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Conc	Result
10	10.0
3	3.0
1	1.0

Intertidal ammonia Day 0 5-29-98 BC

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group: Blank

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1 (0721F)	0.5																~~5~~			
2	3 (0691F)		0.5																		
3	5 (0751F)			0.5																	
4	14 (0749F)				0.5																
5	27 (0728F)					0.5															
6	41 (0730F)						0.5														
7	44 (0723F)							0.5													
8	68 (0692F)								0.5												
9	74 (0748F)									~~0.5~~											
10	82 (0722F)										0.5										
11	87 (0729F)											0.5									
12	90 (0690F)												0.5								
13	101 (0727F)													0.5							
14	108 (0750F)														0.5						
15																					
16																					
17																					
18																		5.0			
	Seawater	4.5																~~0~~			
	Measured concentration (mg/L)	0.7	1.0	1.4	1.9	0.8	0.4	0.1	0.7	~~0.5~~	~~0.2~~ 0.5	~~0.2~~ 0.2	0.2	0.7	1.8			<0.2			
	x multiplier	10																1			
	Final concentration (mg/L)	7.0	10.0	14.0	19.0	8.0	4.0	1.0	7.0	—	5.0	2.0	2.0	7.0	18.0			<0.2			

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing.

*#74 - Not enough water BC

10	10.0
3	3.0
1	1.0

Day 5 6-3-98 Intertidal Ammonia BC

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	2 (0727F)	.5																			
* 2	10 (0748F)		*																		
3	29 (0672F)			5																	
4	33 (0721F)				5																
5	49 (0730F)					5															
6	53 (0750F)						5														
7	57 (0751F)							5													
8	60 (0749F)								5												
9	70 (0725F)									5											
10	81 (0722F)										.5										
11	83 (0691F)											.5									
12	95 (0690F)												.5								
13	104 (0729F)													.5							
14	111 (0723F)														.5						
15																					
16																					
17																					
18																					
	Seawater	4.5																			
	Measured concentration (mg/L)	0.4	—	0.4	0.4	0.3	1.1	0.6	1.1	0.4	0.4	0.2	0.1	0.1	0.2						
	x multiplier	10																			
	Final concentration (mg/L)	1.0	—	4.0	4.0	3.0	11.0	6.0	11.0	4.0	4.0	2.0	1.0	1.0	2.0						

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanuarate reagent packet contents with mixing.

* Not enough water BC

Ammonia

Ammonia Standard

conc	measured
10	10.0
3.0	3.0
1.0	1.0

Intertidal Ammonia Day 10 6-8-98 BC

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	6 (0723F)	0.5																			
2	12 (0749F)		0.5																		
3	20 (0729F)			0.5																	
4	21 (0751F)				0.5																
5	31 (0722F)					0.5															
6	39 (0692F)						0.5														
7	50 (0727F)							0.5													
8	61 (0750F)								0.5												
9	66 (0730F)									0.5											
10	72 (0721F)										0.5										
11	77 (0691F)											0.5									
12	91 (0725F)												0.5								
13	103 (0690F)													0.5							
* 14	105 (0748F)														~~0.5~~	~~5.0~~	~~1.0~~				
15																					
16																					
17																					
18																					
	Seawater	4.5																			
	Measured concentration (mg/L)	0.2	1.0	0.2	0.3	0.3	0.1	0.4	0.5	0.3	0.2	0.1	0.1	0.1	~~<0.1~~ 3	~~5.0~~ 0 <0.1					
	x multiplier	10																			
	Final concentration (mg/L)	2.0	10.0	2.0	3.0	3.0	1.0	4.0	5.0	3.0	2.0	1.0	1.0	1.0	~~<1.0~~ 3	<0.1 1					

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanuarate reagent packet contents with mixing.

* Not enough water for analysis

Interstitial sulfide Day 0 5-29 98 BC

ANALYSIS BENCHSHEET - SULFIDE

Description of analytical group: Blank

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1 (0721F)	0.5																~~5~~	5.0		
2	3 (0691F)		0.5																		
3	5 (0751F)			0.5																	
4	14 (0749F)				0.5																
5	27 (0728F)					0.5															
6	41 (0730F)						0.5														
7	44 (0723F)							0.5													
8	68 (0693F)								0.5												
9	* 74 (0748F)									~~0.5~~											
10	82 (0722F)										0.5										
11	87 (0729F)											0.5									
12	90 (0690F)												0.5								
13	101 (0727F)													0.5							
14	108 (0750F)														0.5						
15																					
16																					
17																					
18																					
	Seawater or DI water	4.5																~~4.0~~	5.0		
	Measured concentration (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	~~<0.01~~ BC	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01			
	x multiplier	10																1			
	Final concentration (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~~<0.1~~ BC	<0.1	<0.1	<0.1	<0.1	<0.1			<0.01			

Add sufficient seawater to make 5 ml. Then add 0.2 ml sulfuric acid reagent (stir), followed by 0.2 ml dichromate reagent (stir)

* #74 - Not enough water BC

Day 5 6.3.98 Interstitial ~~Sulfide~~ Sulfide BC

ANALYSIS BENCHSHEET - SULFIDE

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	2 (0727F)	.5																			
* 2	16 (0748F)		X																		
3	29 (0612F)			.5																	
4	33 (0721F)				5																
5	49 (0730F)					.5															
6	53 (0750F)						.5														
7	57 (0751F)							5													
8	66 (0749F)								.5												
9	70 (0728F)									.5											
10	81 (0722F)										.5										
11	83 (0691F)											.5									
12	95 (0690F)												.5								
13	104 (0727F)													.5							
14	111 (0723F)														.5						
15																					
16																					
17																					
18																					
	Seawater or DI water	4.5																			
	Measured concentration (mg/L)	<0.01	—	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01						
	x multiplier	10																			
	Final concentration (mg/L)	<0.1	—	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1						

Add sufficient seawater to make 5 ml Then add 0.2 ml sulfuric acid reagent (stir), followed by 0.2 ml dichromate reagent (stir)

* Not enough water

BENCHSH.XLS

Interstitial sulfide Day 10 6-8-98 BC

ANALYSIS BENCHSHEET - SULFIDE

	Description of analytical group																				
																Bigall					
	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	6 (0723F)	0.5																			
2	12 (0749F)		0.5																		
3	20 (0729F)			0.5																	
4	21 (0751F)				0.5																
5	31 (0722F)					0.5															
6	39 (0692F)						0.5														
7	56 (0727F)							0.5													
8	61 (0750F)								0.5												
9	66 (0730F)									0.5											
10	72 (0721F)										0.5										
11	77 (0691F)											0.5									
12	91 (0728F)												0.5								
13	103 (0690F)													0.5							
14	105 (0748F)														~~1~~	~~5~~	~~PRA~~				
15																					
16																					
17																					
18																5.0					
	Seawater or DI water	4.5														~~0~~					
	Measured concentration (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	~~<0.01~~	<0.01					
	x multiplier	10													~~5~~	1					
	Final concentration (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	~~<0.1~~	<0.01					
															~~PRA~~						

Add sufficient seawater to make 5 ml. Then add 0.2 ml sulfuric acid reagent (stir), followed by 0.2 ml dichromate reagent (stir)

* Not enough water for analysis

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NAS# 0743F

Amphipod Collection Data Sheet	
Sold to	Northwestern Aquatic Sciences Attn: Michele Redmond 5144 Yaquina Bay Road Newport, OR 97365
Species	Rhepoxynius abronius
Field Collection Notes	
Location	West Beach, Whidbey Island, WA
Data Collected	5/25/98
Number Collected	4,000 +
Temperature	11 °C
pH	7.8
Dissolved Oxygen	94 %
Salinity	30 ‰
Notes	
Holding Conditions	
Temperature	12 °C
Notes	
Shipping Date	5/26/98

Marine Amphipod Test - *Rhepoxynius abronius*
Randomization Key

BKR	NAS SMPL	CLIENT DESCRIP	REPL	
7	0690F	MWAS022R1	1	
8	0690F	MWAS022R1	2	
63	0690F	MWAS022R1	3	
25	0690F	MWAS022R1	4	
28	0690F	MWAS022R1	5	
103	0690F	MWAS022R1	6	water quality beaker
95	0690F	MWAS022R1	7	ay 5 sacrificial beake
90	0690F	MWAS022R1	8	ay 0 sacrificial beake
100	0691F	MWAS024R1	1	
48	0691F	MWAS024R1	2	
92	0691F	MWAS024R1	3	
69	0691F	MWAS024R1	4	
86	0691F	MWAS024R1	5	
77	0691F	MWAS024R1	6	water quality beaker
83	0691F	MWAS024R1	7	ay 5 sacrificial beake
3	0691F	MWAS024R1	8	ay 0 sacrificial beake
99	0692F	MWAS025R1	1	
35	0692F	MWAS025R1	2	
55	0692F	MWAS025R1	3	
93	0692F	MWAS025R1	4	
64	0692F	MWAS025R1	5	
39	0692F	MWAS025R1	6	water quality beaker
29	0692F	MWAS025R1	7	ay 5 sacrificial beake
68	0692F	MWAS025R1	8	ay 0 sacrificial beake
54	0721F	MWAT040R1	1	
30	0721F	MWAT040R1	2	
11	0721F	MWAT040R1	3	
18	0721F	MWAT040R1	4	
37	0721F	MWAT040R1	5	
72	0721F	MWAT040R1	6	water quality beaker
33	0721F	MWAT040R1	7	ay 5 sacrificial beake
1	0721F	MWAT040R1	8	ay 0 sacrificial beake
19	0722F	MWAT049R1	1	
102	0722F	MWAT049R1	2	
24	0722F	MWAT049R1	3	
15	0722F	MWAT049R1	4	
42	0722F	MWAT049R1	5	
31	0722F	MWAT049R1	6	water quality beaker
81	0722F	MWAT049R1	7	ay 5 sacrificial beake
82	0722F	MWAT049R1	8	ay 0 sacrificial beake
43	0723F	MWAT054R1	1	
89	0723F	MWAT054R1	2	
17	0723F	MWAT054R1	3	
38	0723F	MWAT054R1	4	
58	0723F	MWAT054R1	5	
6	0723F	MWAT054R1	6	water quality beaker
111	0723F	MWAT054R1	7	ay 5 sacrificial beake
44	0723F	MWAT054R1	8	ay 0 sacrificial beake
51	0727F	MWAT039R1	1	
98	0727F	MWAT039R1	2	
34	0727F	MWAT039R1	3	
76	0727F	MWAT039R1	4	
56	0727F	MWAT039R1	5	
50	0727F	MWAT039R1	6	water quality beaker
2	0727F	MWAT039R1	7	ay 5 sacrificial beake
101	0727F	MWAT039R1	8	ay 0 sacrificial beake
67	0728F	MWAT043R1	1	

BKR	NAS SMPL	CLIENT DESCRIP	REPL	
26	0728F	MWAT043R1	2	
96	0728F	MWAT043R1	3	
71	0728F	MWAT043R1	4	
45	0728F	MWAT043R1	5	
91	0728F	MWAT043R1	6	water quality beaker
70	0728F	MWAT043R1	7	ay 5 sacrificial beake
27	0728F	MWAT043R1	8	ay 0 sacrificial beake
110	0729F	MWAT048R1	1	
36	0729F	MWAT048R1	2	
40	0729F	MWAT048R1	3	
88	0729F	MWAT048R1	4	
84	0729F	MWAT048R1	5	
20	0729F	MWAT048R1	6	water quality beaker
104	0729F	MWAT048R1	7	ay 5 sacrificial beake
87	0729F	MWAT048R1	8	ay 0 sacrificial beake
75	0730F	MWAT052R1	1	
78	0730F	MWAT052R1	2	
47	0730F	MWAT052R1	3	
79	0730F	MWAT052R1	4	
13	0730F	MWAT052R1	5	
66	0730F	MWAT052R1	6	water quality beaker
49	0730F	MWAT052R1	7	ay 5 sacrificial beake
41	0730F	MWAT052R1	8	ay 0 sacrificial beake
32	0748F	control	1	
22	0748F	control	2	
62	0748F	control	3	
97	0748F	control	4	
59	0748F	control	5	
105	0748F	control	6	water quality beaker
10	0748F	control	7	ay 5 sacrificial beake
74	0748F	control	8	ay 0 sacrificial beake
52	REF 1	REF 1	1	
73	REF 1	REF 1	2	
109	REF 1	REF 1	3	
46	REF 1	REF 1	4	
107	REF 1	REF 1	5	
12	REF 1	REF 1	6	water quality beaker
60	REF 1	REF 1	7	ay 5 sacrificial beake
14	REF 1	REF 1	8	ay 0 sacrificial beake
112	REF 2	REF 2	1	
94	REF 2	REF 2	2	
80	REF 2	REF 2	3	
85	REF 2	REF 2	4	
9	REF 2	REF 2	5	
61	REF 2	REF 2	6	water quality beaker
53	REF 2	REF 2	7	ay 5 sacrificial beake
108	REF 2	REF 2	8	ay 0 sacrificial beake
23	REF 3	REF 3	1	
16	REF 3	REF 3	2	
65	REF 3	REF 3	3	
4	REF 3	REF 3	4	
106	REF 3	REF 3	5	
21	REF 3	REF 3	6	water quality beaker
57	REF 3	REF 3	7	ay 5 sacrificial beake
5	REF 3	REF 3	8	ay 0 sacrificial beake

RK 7/22/98 0749F

MWRC208R1
MWRC209R1

RK 7/22/98

" 0750F

" 0751F

MWRC210R1

Endpoints Data Entry and Calculations File

INIT=initial number
SURV=number survivors
REBUR=number survivors which reburied
MORT=number dead=INIT-SURV
NOBURY=number survivors not reburied=SURV-REBUR
FINAL IW PPT=interstitial salinity on day 10

TEM=total effective mortality=MORT+NOBURY
INIT=initial number of amphipods
SURV=number of surviving amphipods
REBUR=number of surviving amphipods reburying
PSURV=%survival=100(SURV/INIT)
PMORT=%mortality=100(MORT/INIT)
PBURY=%reburial=100(REBUR/SURV)
PNOBURY=%survivors not reburied=100(NOBURY/SURV)
PTEM=%total effective mortality=100(TEM/INIT)

Data entry verified against laboratory bench sheets. MLR 6-16-98

INDE	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	FINAL IW PPT	SURV	REBUR	MORT	NOBUR	TEM	PSURV	PMORT	PBURY	PNOBURY	PTEM
1	7	0690F	MWAS022R1	1		20	29.0	19	18	1	1	2	95.0	5.0	94.7	5.3	10.0
2	8	0690F	MWAS022R1	2		20	29.5	17	17	3	0	3	85.0	15.0	100.0	0.0	15.0
3	63	0690F	MWAS022R1	3		20	28.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0
4	25	0690F	MWAS022R1	4		20	28.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0
5	28	0690F	MWAS022R1	5		20	29.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0
6	103	0690F	MWAS022R1	6	water quality beaker	20	29.0										
7	95	0690F	MWAS022R1	7	day 5 sacrificial beaker	20											
8	90	0690F	MWAS022R1	8	day 0 sacrificial beaker												
9	100	0691F	MWAS024R1	1		20	27.5	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0
10	48	0691F	MWAS024R1	2		20	27.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0
11	92	0691F	MWAS024R1	3		20	27.0	16	14	4	2	6	80.0	20.0	87.5	12.5	30.0
12	69	0691F	MWAS024R1	4		20	28.0	14	14	6	0	6	70.0	30.0	100.0	0.0	30.0
13	86	0691F	MWAS024R1	5		20	28.0	16	16	4	0	4	80.0	20.0	100.0	0.0	20.0
14	77	0691F	MWAS024R1	6	water quality beaker	20	28.0										
15	83	0691F	MWAS024R1	7	day 5 sacrificial beaker	20											
16	3	0691F	MWAS024R1	8	day 0 sacrificial beaker												
17	99	0692F	MWAS025R1	1		20	27.0	16	16	4	0	4	80.0	20.0	100.0	0.0	20.0
18	35	0692F	MWAS025R1	2		20	29.5	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0
19	55	0692F	MWAS025R1	3		20	27.0	17	17	3	0	3	85.0	15.0	100.0	0.0	15.0
20	93	0692F	MWAS025R1	4		20	27.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0
21	64	0692F	MWAS025R1	5		20	28.0	17	17	3	0	3	85.0	15.0	100.0	0.0	15.0
22	39	0692F	MWAS025R1	6	water quality beaker	20	29.5										
23	29	0692F	MWAS025R1	7	day 5 sacrificial beaker	20											
24	68	0692F	MWAS025R1	8	day 0 sacrificial beaker												
25	54	0721F	MWAT040R1	1		20	27.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0
26	30	0721F	MWAT040R1	2		20	29.5	19	18	1	1	2	95.0	5.0	94.7	5.3	10.0
27	11	0721F	MWAT040R1	3		20	30.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0
28	18	0721F	MWAT040R1	4		20	28.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0
29	37	0721F	MWAT040R1	5		20	29.0	20	19	0	1	1	100.0	0.0	95.0	5.0	5.0
30	72	0721F	MWAT040R1	6	water quality beaker	20	28.0										
31	33	0721F	MWAT040R1	7	day 5 sacrificial beaker	20											
32	1	0721F	MWAT040R1	8	day 0 sacrificial beaker												
33	19	0722F	MWAT049R1	1		20	29.5	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0
34	102	0722F	MWAT049R1	2		20	29.0	18	17	2	1	3	90.0	10.0	94.4	5.6	15.0
35	24	0722F	MWAT049R1	3		20	29.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0
36	15	0722F	MWAT049R1	4		20	29.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0
37	42	0722F	MWAT049R1	5		20	28.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0
38	31	0722F	MWAT049R1	6	water quality beaker	20	29.5										

	FINAL IW PPT	SURV	MORT	NOBURY	PSURV	PMORT	PBURY	PNOBURY	PTEM
Mean	28.8	18.6	1.4	0.2	93.0	7.0	98.9	1.1	8.0
SD	0.7	0.9	0.9	0.4	4.5	4.5	2.4	2.4	4.5
n	6	5	5	5	5	5	5	5	5
Mean	27.6	16.4	3.6	0.4	82.0	18.0	97.5	2.5	20.0
SD	0.5	1.7	1.7	0.9	8.4	8.4	5.6	5.6	10.0
n	6	5	5	5	5	5	5	5	5
Mean	28.0	17.8	2.2	0.0	89.0	11.0	100.0	0.0	11.0
SD	1.2	1.6	1.6	0.0	8.2	8.2	0.0	0.0	8.2
n	6	5	5	5	5	5	5	5	5
Mean	28.6	19.2	0.8	0.4	96.0	4.0	97.9	2.1	6.0
SD	1.1	0.8	0.8	0.5	4.2	4.2	2.6	2.8	4.2
n	6	5	5	5	5	5	5	5	5
Mean	29.0	19.2	0.8	0.2	96.0	4.0	98.9	1.1	5.0
SD	0.5	1.1	1.1	0.4	5.5	5.5	2.5	2.5	7.1
n	6	5	5	5	5	5	5	5	5

INDE	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	FINAL IW PPT	SURV	REBUR	MORT	NOBUR	TEM	PSURV	PMORT	PBURY	PNOBURY	PTEM		FINAL IW PPT	SURV	MORT	NOBURY	PSURV	PMORT	PBURY	PNOBURY	PTEM
39	81	0722F	MWAT049R1	7	day 5 sacrificial beaker	20																					
40	82	0722F	MWAT049R1	8	day 0 sacrificial beaker																						
41	43	0723F	MWAT054R1	1		20	28.0	18	17	2	1	3	90.0	10.0	94.4	5.6	15.0										
42	89	0723F	MWAT054R1	2		20	27.0	17	17	3	0	3	85.0	15.0	100.0	0.0	15.0	Mean	28.5	18.2	1.8	0.4	91.0	9.0	97.8	2.2	11.0
43	17	0723F	MWAT054R1	3		20	29.0	19	18	1	1	2	95.0	5.0	94.7	5.3	10.0	SD	1.2	0.8	0.8	0.5	4.2	4.2	3.0	3.0	4.2
44	38	0723F	MWAT054R1	4		20	30.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0	n	6	5	5	5	5	5	5	5	5
45	58	0723F	MWAT054R1	5		20	27.5	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0										
46	6	0723F	MWAT054R1	6	water quality beaker	20	29.5																				
47	111	0723F	MWAT054R1	7	day 5 sacrificial beaker	20																					
48	44	0723F	MWAT054R1	8	day 0 sacrificial beaker																						
49	51	0727F	MWAT039R1	1		20	28.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0										
50	98	0727F	MWAT039R1	2		20	28.5	18	17	2	1	3	90.0	10.0	94.4	5.6	15.0	Mean	28.3	18.8	1.2	0.4	94.0	6.0	97.8	2.2	8.0
51	34	0727F	MWAT039R1	3		20	28.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0	SD	0.8	0.4	0.4	0.5	2.2	2.2	3.0	3.0	4.5
52	76	0727F	MWAT039R1	4		20	28.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0	n	6	5	5	5	5	5	5	5	5
53	56	0727F	MWAT039R1	5		20	27.0	19	18	1	1	2	95.0	5.0	94.7	5.3	10.0										
54	50	0727F	MWAT039R1	6	water quality beaker	20	29.5																				
55	2	0727F	MWAT039R1	7	day 5 sacrificial beaker	20																					
56	101	0727F	MWAT039R1	8	day 0 sacrificial beaker																						
57	67	0728F	MWAT043R1	1		20	27.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0										
58	26	0728F	MWAT043R1	2		20	29.5	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0	Mean	28.1	19.0	1.0	0.0	95.0	5.0	100.0	0.0	5.0
59	96	0728F	MWAT043R1	3		20	28.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0	SD	0.9	1.0	1.0	0.0	5.0	5.0	0.0	0.0	5.0
60	71	0728F	MWAT043R1	4		20	28.5	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0	n	6	5	5	5	5	5	5	5	5
61	45	0728F	MWAT043R1	5		20	27.5	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0										
62	91	0728F	MWAT043R1	6	water quality beaker	20	28.0																				
63	70	0728F	MWAT043R1	7	day 5 sacrificial beaker	20																					
64	27	0728F	MWAT043R1	8	day 0 sacrificial beaker																						
65	110	0729F	MWAT048R1	1		20	27.0	16	16	4	0	4	80.0	20.0	100.0	0.0	20.0										
66	36	0729F	MWAT048R1	2		20	29.5	20	19	0	1	1	100.0	0.0	95.0	5.0	5.0	Mean	28.3	18.0	2.0	0.4	90.0	10.0	97.8	2.3	12.0
67	40	0729F	MWAT048R1	3		20	30.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0	SD	1.5	1.9	1.9	0.5	9.4	9.4	3.1	3.1	9.7
68	88	0729F	MWAT048R1	4		20	27.0	16	15	4	1	5	80.0	20.0	93.8	6.3	25.0	n	6	5	5	5	5	5	5	5	5
69	84	0729F	MWAT048R1	5		20	27.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0										
70	20	0729F	MWAT048R1	6	water quality beaker	20	29.5																				
71	104	0729F	MWAT048R1	7	day 5 sacrificial beaker	20																					
72	87	0729F	MWAT048R1	8	day 0 sacrificial beaker																						
73	75	0730F	MWAT052R1	1		20	27.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0										
74	78	0730F	MWAT052R1	2		20	27.0	20	19	0	1	1	100.0	0.0	95.0	5.0	5.0	Mean	27.8	18.8	1.2	0.8	94.0	6.0	95.9	4.1	10.0
75	47	0730F	MWAT052R1	3		20	27.0	17	17	3	0	3	85.0	15.0	100.0	0.0	15.0	SD	1.0	1.3	1.3	0.8	6.5	6.5	4.2	4.2	3.5
76	79	0730F	MWAT052R1	4		20	28.0	19	18	1	1	2	95.0	5.0	94.7	5.3	10.0	n	6	5	5	5	5	5	5	5	5
77	13	0730F	MWAT052R1	5		20	29.5	20	18	0	2	2	100.0	0.0	90.0	10.0	10.0										
78	66	0730F	MWAT052R1	6	water quality beaker	20	28.0																				
79	49	0730F	MWAT052R1	7	day 5 sacrificial beaker	20																					
80	41	0730F	MWAT052R1	8	day 0 sacrificial beaker																						
81	32	0748F	control	1		20	29.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0										
82	22	0748F	control	2		20	29.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0	Mean	28.2	19.8	0.2	0.0	99.0	1.0	100.0	0.0	1.0
83	62	0748F	control	3		20	27.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0	SD	1.1	0.4	0.4	0.0	2.2	2.2	0.0	0.0	2.2
84	97	0748F	control	4		20	27.5	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0	n	6	5	5	5	5	5	5	5	5
85	59	0748F	control	5		20	27.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0										
86	105	0748F	control	6	water quality beaker	20	29.0																				
87	10	0748F	control	7	day 5 sacrificial beaker	20																					
88	74	0748F	control	8	day 0 sacrificial beaker																						

INDE	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT	FINAL IW PPT	SURV	REBUR	MORT	NOBUR	TEM	PSURV	PMORT	PBURY	PNOBURY	PTEM			FINAL IW PPT	SURV	MORT	NOBURY	PSURV	PMORT	PBURY	PNOBURY	PTEM
89	52	0749F	MWRC208R1	1		20	28.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0											
90	73	0749F	MWRC208R1	2		20	29.0	19	18	1	1	2	95.0	5.0	94.7	5.3	10.0		Mean	28.6	19.0	1.0	0.4	95.0	5.0	97.9	2.1	7.0
91	109	0749F	MWRC208R1	3		20	28.0	20	19	0	1	1	100.0	0.0	95.0	5.0	5.0		SD	0.9	0.7	0.7	0.5	3.5	3.5	2.8	2.8	2.7
92	46	0749F	MWRC208R1	4		20	27.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0		n	6	5	5	5	5	5	5	5	5
93	107	0749F	MWRC208R1	5		20	29.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0											
94	12	0749F	MWRC208R1	6	water quality beaker	20	29.5																					
95	60	0749F	MWRC208R1	7	day 5 sacrificial beaker	20																						
96	14	0749F	MWRC208R1	8	day 0 sacrificial beaker																							
97	112	0750F	MWRC209R1	1		20	29.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0											
98	94	0750F	MWRC209R1	2		20	27.0	20	20	0	0	0	100.0	0.0	100.0	0.0	0.0		Mean	28.3	19.4	0.6	0.2	97.0	3.0	99.0	1.0	4.0
99	80	0750F	MWRC209R1	3		20	28.0	20	19	0	1	1	100.0	0.0	95.0	5.0	5.0		SD	1.2	0.9	0.9	0.4	4.5	4.5	2.2	2.2	4.2
100	85	0750F	MWRC209R1	4		20	27.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0		n	6	5	5	5	5	5	5	5	5
101	9	0750F	MWRC209R1	5		20	29.5	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0											
102	61	0750F	MWRC209R1	6	water quality beaker	20	29.5																					
103	53	0750F	MWRC209R1	7	day 5 sacrificial beaker	20																						
104	108	0750F	MWRC209R1	8	day 0 sacrificial beaker																							
105	23	0751F	MWRC210R1	1		20	28.0	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0											
106	16	0751F	MWRC210R1	2		20	28.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0		Mean	28.7	18.8	1.2	0.2	94.0	6.0	99.0	1.0	7.0
107	65	0751F	MWRC210R1	3		20	28.0	20	19	0	1	1	100.0	0.0	95.0	5.0	5.0		SD	0.8	0.8	0.8	0.4	4.2	4.2	2.2	2.2	2.7
108	4	0751F	MWRC210R1	4		20	29.5	19	19	1	0	1	95.0	5.0	100.0	0.0	5.0		n	6	5	5	5	5	5	5	5	5
109	106	0751F	MWRC210R1	5		20	29.0	18	18	2	0	2	90.0	10.0	100.0	0.0	10.0											
110	21	0751F	MWRC210R1	6	water quality beaker	20	29.5																					
111	57	0751F	MWRC210R1	7	day 5 sacrificial beaker	20																						
112	5	0751F	MWRC210R1	8	day 0 sacrificial beaker																							

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
1	7	0690F	MWAS022R1	1	1	2			
1	7	0690F	MWAS022R1	1	2	1			
1	7	0690F	MWAS022R1	1	3	0			
1	7	0690F	MWAS022R1	1	4	2			
1	7	0690F	MWAS022R1	1	5	0			
1	7	0690F	MWAS022R1	1	6	0			
1	7	0690F	MWAS022R1	1	7	1			
1	7	0690F	MWAS022R1	1	8	0			
1	7	0690F	MWAS022R1	1	9	0			
1	7	0690F	MWAS022R1	1	10	2	8		
2	8	0690F	MWAS022R1	2	1	0			
2	8	0690F	MWAS022R1	2	2	0			
2	8	0690F	MWAS022R1	2	3	0			
2	8	0690F	MWAS022R1	2	4	0			
2	8	0690F	MWAS022R1	2	5	0			
2	8	0690F	MWAS022R1	2	6	0			
2	8	0690F	MWAS022R1	2	7	1			
2	8	0690F	MWAS022R1	2	8	2			
2	8	0690F	MWAS022R1	2	9	0			
2	8	0690F	MWAS022R1	2	10	1	4		
3	63	0690F	MWAS022R1	3	1	0			
3	63	0690F	MWAS022R1	3	2	0			
3	63	0690F	MWAS022R1	3	3	1			
3	63	0690F	MWAS022R1	3	4	0			
3	63	0690F	MWAS022R1	3	5	0			
3	63	0690F	MWAS022R1	3	6	0			
3	63	0690F	MWAS022R1	3	7	0			
3	63	0690F	MWAS022R1	3	8	0			
3	63	0690F	MWAS022R1	3	9	0			
3	63	0690F	MWAS022R1	3	10	2	3		
4	25	0690F	MWAS022R1	4	1	1			
4	25	0690F	MWAS022R1	4	2	0			
4	25	0690F	MWAS022R1	4	3	0			
4	25	0690F	MWAS022R1	4	4	0			
4	25	0690F	MWAS022R1	4	5	0			
4	25	0690F	MWAS022R1	4	6	0			
4	25	0690F	MWAS022R1	4	7	0			
4	25	0690F	MWAS022R1	4	8	1			
4	25	0690F	MWAS022R1	4	9	0			
4	25	0690F	MWAS022R1	4	10	0	2		
5	28	0690F	MWAS022R1	5	1	0			
5	28	0690F	MWAS022R1	5	2	0			
5	28	0690F	MWAS022R1	5	3	0		Mean	3.6
5	28	0690F	MWAS022R1	5	4	0		SD	2.7
5	28	0690F	MWAS022R1	5	5	0		n	5
5	28	0690F	MWAS022R1	5	6	0			
5	28	0690F	MWAS022R1	5	7	0			

Data entry verified against laboratory bench sheets - MdK 7-17-98

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
5	28	0690F	MWAS022R1	5	8	0			
5	28	0690F	MWAS022R1	5	9	0			
5	28	0690F	MWAS022R1	5	10	1	1		
9	100	0691F	MWAS024R1	1	1	0			
9	100	0691F	MWAS024R1	1	2	0			
9	100	0691F	MWAS024R1	1	3	0			
9	100	0691F	MWAS024R1	1	4	0			
9	100	0691F	MWAS024R1	1	5	0			
9	100	0691F	MWAS024R1	1	6	0			
9	100	0691F	MWAS024R1	1	7	0			
9	100	0691F	MWAS024R1	1	8	1			
9	100	0691F	MWAS024R1	1	9	0			
9	100	0691F	MWAS024R1	1	10	2	3		
10	48	0691F	MWAS024R1	2	1	0			
10	48	0691F	MWAS024R1	2	2	0			
10	48	0691F	MWAS024R1	2	3				
10	48	0691F	MWAS024R1	2	4	1			
10	48	0691F	MWAS024R1	2	5	1			
10	48	0691F	MWAS024R1	2	6	1			
10	48	0691F	MWAS024R1	2	7	2			
10	48	0691F	MWAS024R1	2	8	3			
10	48	0691F	MWAS024R1	2	9	2			
10	48	0691F	MWAS024R1	2	10	2	12		
11	92	0691F	MWAS024R1	3	1	0			
11	92	0691F	MWAS024R1	3	2	0			
11	92	0691F	MWAS024R1	3	3	1			
11	92	0691F	MWAS024R1	3	4	2			
11	92	0691F	MWAS024R1	3	5	0			
11	92	0691F	MWAS024R1	3	6	0			
11	92	0691F	MWAS024R1	3	7	5			
11	92	0691F	MWAS024R1	3	8	0			
11	92	0691F	MWAS024R1	3	9	4			
11	92	0691F	MWAS024R1	3	10	1	13		
12	69	0691F	MWAS024R1	4	1	0			
12	69	0691F	MWAS024R1	4	2	0			
12	69	0691F	MWAS024R1	4	3	0			
12	69	0691F	MWAS024R1	4	4	0			
12	69	0691F	MWAS024R1	4	5	0			
12	69	0691F	MWAS024R1	4	6	0			
12	69	0691F	MWAS024R1	4	7	0			
12	69	0691F	MWAS024R1	4	8	0			
12	69	0691F	MWAS024R1	4	9	2			
12	69	0691F	MWAS024R1	4	10	2	4		
13	86	0691F	MWAS024R1	5	1	0			
13	86	0691F	MWAS024R1	5	2	0			
13	86	0691F	MWAS024R1	5	3	0		Mean	7.2
13	86	0691F	MWAS024R1	5	4	0		SD	4.9

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG	n	
13	86	0691F	MWAS024R1	5	5	0			5
13	86	0691F	MWAS024R1	5	6	0			
13	86	0691F	MWAS024R1	5	7	2			
13	86	0691F	MWAS024R1	5	8	2			
13	86	0691F	MWAS024R1	5	9	0			
13	86	0691F	MWAS024R1	5	10	0	4		
17	99	0692F	MWAS025R1	1	1	0			
17	99	0692F	MWAS025R1	1	2	0			
17	99	0692F	MWAS025R1	1	3	0			
17	99	0692F	MWAS025R1	1	4	1			
17	99	0692F	MWAS025R1	1	5	0			
17	99	0692F	MWAS025R1	1	6	0			
17	99	0692F	MWAS025R1	1	7	2			
17	99	0692F	MWAS025R1	1	8	0			
17	99	0692F	MWAS025R1	1	9	0			
17	99	0692F	MWAS025R1	1	10	1	4		
18	35	0692F	MWAS025R1	2	1	0			
18	35	0692F	MWAS025R1	2	2	0			
18	35	0692F	MWAS025R1	2	3	0			
18	35	0692F	MWAS025R1	2	4	0			
18	35	0692F	MWAS025R1	2	5	0			
18	35	0692F	MWAS025R1	2	6	0			
18	35	0692F	MWAS025R1	2	7	0			
18	35	0692F	MWAS025R1	2	8	0			
18	35	0692F	MWAS025R1	2	9	0			
18	35	0692F	MWAS025R1	2	10	0	0		
19	55	0692F	MWAS025R1	3	1	0			
19	55	0692F	MWAS025R1	3	2	1			
19	55	0692F	MWAS025R1	3	3	0			
19	55	0692F	MWAS025R1	3	4	0			
19	55	0692F	MWAS025R1	3	5	1			
19	55	0692F	MWAS025R1	3	6	4			
19	55	0692F	MWAS025R1	3	7	4			
19	55	0692F	MWAS025R1	3	8	1			
19	55	0692F	MWAS025R1	3	9	0			
19	55	0692F	MWAS025R1	3	10	0	11		
20	93	0692F	MWAS025R1	4	1	0			
20	93	0692F	MWAS025R1	4	2	0			
20	93	0692F	MWAS025R1	4	3	0			
20	93	0692F	MWAS025R1	4	4	0			
20	93	0692F	MWAS025R1	4	5	0			
20	93	0692F	MWAS025R1	4	6	0			
20	93	0692F	MWAS025R1	4	7	2			
20	93	0692F	MWAS025R1	4	8	2			
20	93	0692F	MWAS025R1	4	9	2			
20	93	0692F	MWAS025R1	4	10	3	9		
21	64	0692F	MWAS025R1	5	1	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
21	64	0692F	MWAS025R1	5	2	1			
21	64	0692F	MWAS025R1	5	3	1		Mean	5.6
21	64	0692F	MWAS025R1	5	4	0		SD	4.4
21	64	0692F	MWAS025R1	5	5	0		n	5
21	64	0692F	MWAS025R1	5	6	0			
21	64	0692F	MWAS025R1	5	7	0			
21	64	0692F	MWAS025R1	5	8	1			
21	64	0692F	MWAS025R1	5	9	1			
21	64	0692F	MWAS025R1	5	10	0	4		
25	54	0721F	MWAT040R1	1	1	0			
25	54	0721F	MWAT040R1	1	2	0			
25	54	0721F	MWAT040R1	1	3	1			
25	54	0721F	MWAT040R1	1	4	0			
25	54	0721F	MWAT040R1	1	5	0			
25	54	0721F	MWAT040R1	1	6	0			
25	54	0721F	MWAT040R1	1	7	0			
25	54	0721F	MWAT040R1	1	8	0			
25	54	0721F	MWAT040R1	1	9	0			
25	54	0721F	MWAT040R1	1	10	2	3		
26	30	0721F	MWAT040R1	2	1	0			
26	30	0721F	MWAT040R1	2	2	0			
26	30	0721F	MWAT040R1	2	3	0			
26	30	0721F	MWAT040R1	2	4	1			
26	30	0721F	MWAT040R1	2	5	0			
26	30	0721F	MWAT040R1	2	6	0			
26	30	0721F	MWAT040R1	2	7	0			
26	30	0721F	MWAT040R1	2	8	0			
26	30	0721F	MWAT040R1	2	9	1			
26	30	0721F	MWAT040R1	2	10	0	2		
27	11	0721F	MWAT040R1	3	1	0			
27	11	0721F	MWAT040R1	3	2	0			
27	11	0721F	MWAT040R1	3	3	0			
27	11	0721F	MWAT040R1	3	4	1			
27	11	0721F	MWAT040R1	3	5	0			
27	11	0721F	MWAT040R1	3	6	0			
27	11	0721F	MWAT040R1	3	7	1			
27	11	0721F	MWAT040R1	3	8	1			
27	11	0721F	MWAT040R1	3	9	1			
27	11	0721F	MWAT040R1	3	10	1	5		
28	18	0721F	MWAT040R1	4	1	0			
28	18	0721F	MWAT040R1	4	2	0			
28	18	0721F	MWAT040R1	4	3	0			
28	18	0721F	MWAT040R1	4	4	0			
28	18	0721F	MWAT040R1	4	5	0			
28	18	0721F	MWAT040R1	4	6	0			
28	18	0721F	MWAT040R1	4	7	0			
28	18	0721F	MWAT040R1	4	8	1			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
28	18	0721F	MWAT040R1	4	9	0			
28	18	0721F	MWAT040R1	4	10	0	1		
29	37	0721F	MWAT040R1	5	1	0			
29	37	0721F	MWAT040R1	5	2	0			
29	37	0721F	MWAT040R1	5	3	0		Mean	2.8
29	37	0721F	MWAT040R1	5	4	0		SD	1.5
29	37	0721F	MWAT040R1	5	5	0		n	5
29	37	0721F	MWAT040R1	5	6	0			
29	37	0721F	MWAT040R1	5	7	0			
29	37	0721F	MWAT040R1	5	8	0			
29	37	0721F	MWAT040R1	5	9	2			
29	37	0721F	MWAT040R1	5	10	1	3		
33	19	0722F	MWAT049R1	1	1	0			
33	19	0722F	MWAT049R1	1	2	0			
33	19	0722F	MWAT049R1	1	3	0			
33	19	0722F	MWAT049R1	1	4	0			
33	19	0722F	MWAT049R1	1	5	1			
33	19	0722F	MWAT049R1	1	6	0			
33	19	0722F	MWAT049R1	1	7	1			
33	19	0722F	MWAT049R1	1	8	0			
33	19	0722F	MWAT049R1	1	9	0			
33	19	0722F	MWAT049R1	1	10	2	4		
34	102	0722F	MWAT049R1	2	1	1			
34	102	0722F	MWAT049R1	2	2	0			
34	102	0722F	MWAT049R1	2	3	0			
34	102	0722F	MWAT049R1	2	4	0			
34	102	0722F	MWAT049R1	2	5	0			
34	102	0722F	MWAT049R1	2	6	0			
34	102	0722F	MWAT049R1	2	7	0			
34	102	0722F	MWAT049R1	2	8	0			
34	102	0722F	MWAT049R1	2	9	0			
34	102	0722F	MWAT049R1	2	10	0	1		
35	24	0722F	MWAT049R1	3	1	0			
35	24	0722F	MWAT049R1	3	2	0			
35	24	0722F	MWAT049R1	3	3	0			
35	24	0722F	MWAT049R1	3	4	0			
35	24	0722F	MWAT049R1	3	5	0			
35	24	0722F	MWAT049R1	3	6	0			
35	24	0722F	MWAT049R1	3	7	0			
35	24	0722F	MWAT049R1	3	8	0			
35	24	0722F	MWAT049R1	3	9	0			
35	24	0722F	MWAT049R1	3	10	0	0		
36	15	0722F	MWAT049R1	4	1	0			
36	15	0722F	MWAT049R1	4	2	0			
36	15	0722F	MWAT049R1	4	3	0			
36	15	0722F	MWAT049R1	4	4	0			
36	15	0722F	MWAT049R1	4	5	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
36	15	0722F	MWAT049R1	4	6	0			
36	15	0722F	MWAT049R1	4	7	0			
36	15	0722F	MWAT049R1	4	8	0			
36	15	0722F	MWAT049R1	4	9	0			
36	15	0722F	MWAT049R1	4	10	0	0		
37	42	0722F	MWAT049R1	5	1	0			
37	42	0722F	MWAT049R1	5	2	0			
37	42	0722F	MWAT049R1	5	3	0		Mean	1.2
37	42	0722F	MWAT049R1	5	4	0		SD	1.6
37	42	0722F	MWAT049R1	5	5	0		n	5
37	42	0722F	MWAT049R1	5	6	0			
37	42	0722F	MWAT049R1	5	7	0			
37	42	0722F	MWAT049R1	5	8	0			
37	42	0722F	MWAT049R1	5	9	0			
37	42	0722F	MWAT049R1	5	10	1	1		
41	43	0723F	MWAT054R1	1	1	1			
41	43	0723F	MWAT054R1	1	2	0			
41	43	0723F	MWAT054R1	1	3	0			
41	43	0723F	MWAT054R1	1	4	0			
41	43	0723F	MWAT054R1	1	5	0			
41	43	0723F	MWAT054R1	1	6	0			
41	43	0723F	MWAT054R1	1	7	0			
41	43	0723F	MWAT054R1	1	8	0			
41	43	0723F	MWAT054R1	1	9	1			
41	43	0723F	MWAT054R1	1	10	1	3		
42	89	0723F	MWAT054R1	2	1	0			
42	89	0723F	MWAT054R1	2	2	0			
42	89	0723F	MWAT054R1	2	3	0			
42	89	0723F	MWAT054R1	2	4	0			
42	89	0723F	MWAT054R1	2	5	0			
42	89	0723F	MWAT054R1	2	6	0			
42	89	0723F	MWAT054R1	2	7	0			
42	89	0723F	MWAT054R1	2	8	3			
42	89	0723F	MWAT054R1	2	9	0			
42	89	0723F	MWAT054R1	2	10	0	3		
43	17	0723F	MWAT054R1	3	1	0			
43	17	0723F	MWAT054R1	3	2	0			
43	17	0723F	MWAT054R1	3	3	0			
43	17	0723F	MWAT054R1	3	4	0			
43	17	0723F	MWAT054R1	3	5	0			
43	17	0723F	MWAT054R1	3	6	0			
43	17	0723F	MWAT054R1	3	7	0			
43	17	0723F	MWAT054R1	3	8	1			
43	17	0723F	MWAT054R1	3	9	2			
43	17	0723F	MWAT054R1	3	10	1	4		
44	38	0723F	MWAT054R1	4	1	0			
44	38	0723F	MWAT054R1	4	2	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
44	38	0723F	MWAT054R1	4	3	0			
44	38	0723F	MWAT054R1	4	4	0			
44	38	0723F	MWAT054R1	4	5	0			
44	38	0723F	MWAT054R1	4	6	0			
44	38	0723F	MWAT054R1	4	7	0			
44	38	0723F	MWAT054R1	4	8	0			
44	38	0723F	MWAT054R1	4	9	1			
44	38	0723F	MWAT054R1	4	10	1	2		
45	58	0723F	MWAT054R1	5	1	0			
45	58	0723F	MWAT054R1	5	2	1			
45	58	0723F	MWAT054R1	5	3	1		Mean	3.6
45	58	0723F	MWAT054R1	5	4	0		SD	1.5
45	58	0723F	MWAT054R1	5	5	1		n	5
45	58	0723F	MWAT054R1	5	6	0			
45	58	0723F	MWAT054R1	5	7	1			
45	58	0723F	MWAT054R1	5	8	1			
45	58	0723F	MWAT054R1	5	9	0			
45	58	0723F	MWAT054R1	5	10	1	6		
49	51	0727F	MWAT039R1	1	1	0			
49	51	0727F	MWAT039R1	1	2	0			
49	51	0727F	MWAT039R1	1	3	0			
49	51	0727F	MWAT039R1	1	4	0			
49	51	0727F	MWAT039R1	1	5	0			
49	51	0727F	MWAT039R1	1	6	0			
49	51	0727F	MWAT039R1	1	7	1			
49	51	0727F	MWAT039R1	1	8	0			
49	51	0727F	MWAT039R1	1	9	1			
49	51	0727F	MWAT039R1	1	10	1	3		
50	98	0727F	MWAT039R1	2	1	0			
50	98	0727F	MWAT039R1	2	2	0			
50	98	0727F	MWAT039R1	2	3	0			
50	98	0727F	MWAT039R1	2	4	0			
50	98	0727F	MWAT039R1	2	5	0			
50	98	0727F	MWAT039R1	2	6	0			
50	98	0727F	MWAT039R1	2	7	0			
50	98	0727F	MWAT039R1	2	8	0			
50	98	0727F	MWAT039R1	2	9	2			
50	98	0727F	MWAT039R1	2	10	1	3		
51	34	0727F	MWAT039R1	3	1	0			
51	34	0727F	MWAT039R1	3	2	1			
51	34	0727F	MWAT039R1	3	3	0			
51	34	0727F	MWAT039R1	3	4	0			
51	34	0727F	MWAT039R1	3	5	1			
51	34	0727F	MWAT039R1	3	6	2			
51	34	0727F	MWAT039R1	3	7	0			
51	34	0727F	MWAT039R1	3	8	0			
51	34	0727F	MWAT039R1	3	9	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
51	34	0727F	MWAT039R1	3	10	2	6		
52	76	0727F	MWAT039R1	4	1	0			
52	76	0727F	MWAT039R1	4	2	0			
52	76	0727F	MWAT039R1	4	3	1			
52	76	0727F	MWAT039R1	4	4	0			
52	76	0727F	MWAT039R1	4	5	0			
52	76	0727F	MWAT039R1	4	6	1			
52	76	0727F	MWAT039R1	4	7	0			
52	76	0727F	MWAT039R1	4	8	0			
52	76	0727F	MWAT039R1	4	9	0			
52	76	0727F	MWAT039R1	4	10	1	3		
53	56	0727F	MWAT039R1	5	1	1			
53	56	0727F	MWAT039R1	5	2	0			
53	56	0727F	MWAT039R1	5	3	0		Mean	3.6
53	56	0727F	MWAT039R1	5	4	1		SD	1.3
53	56	0727F	MWAT039R1	5	5	0		n	5
53	56	0727F	MWAT039R1	5	6	0			
53	56	0727F	MWAT039R1	5	7	0			
53	56	0727F	MWAT039R1	5	8	1			
53	56	0727F	MWAT039R1	5	9	0			
53	56	0727F	MWAT039R1	5	10	0	3		
57	67	0728F	MWAT043R1	1	1	0			
57	67	0728F	MWAT043R1	1	2	0			
57	67	0728F	MWAT043R1	1	3	0			
57	67	0728F	MWAT043R1	1	4	0			
57	67	0728F	MWAT043R1	1	5	0			
57	67	0728F	MWAT043R1	1	6	0			
57	67	0728F	MWAT043R1	1	7	0			
57	67	0728F	MWAT043R1	1	8	0			
57	67	0728F	MWAT043R1	1	9	0			
57	67	0728F	MWAT043R1	1	10	0	0		
58	26	0728F	MWAT043R1	2	1	1			
58	26	0728F	MWAT043R1	2	2	0			
58	26	0728F	MWAT043R1	2	3	0			
58	26	0728F	MWAT043R1	2	4	0			
58	26	0728F	MWAT043R1	2	5	0			
58	26	0728F	MWAT043R1	2	6	0			
58	26	0728F	MWAT043R1	2	7	1			
58	26	0728F	MWAT043R1	2	8	0			
58	26	0728F	MWAT043R1	2	9	0			
58	26	0728F	MWAT043R1	2	10	0	2		
59	96	0728F	MWAT043R1	3	1	0			
59	96	0728F	MWAT043R1	3	2	0			
59	96	0728F	MWAT043R1	3	3	0			
59	96	0728F	MWAT043R1	3	4	0			
59	96	0728F	MWAT043R1	3	5	0			
59	96	0728F	MWAT043R1	3	6	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
59	96	0728F	MWAT043R1	3	7	1			
59	96	0728F	MWAT043R1	3	8	0			
59	96	0728F	MWAT043R1	3	9	0			
59	96	0728F	MWAT043R1	3	10	3	4		
60	71	0728F	MWAT043R1	4	1	0			
60	71	0728F	MWAT043R1	4	2	0			
60	71	0728F	MWAT043R1	4	3	0			
60	71	0728F	MWAT043R1	4	4	2			
60	71	0728F	MWAT043R1	4	5	0			
60	71	0728F	MWAT043R1	4	6	0			
60	71	0728F	MWAT043R1	4	7	0			
60	71	0728F	MWAT043R1	4	8	0			
60	71	0728F	MWAT043R1	4	9	0			
60	71	0728F	MWAT043R1	4	10	0	2		
61	45	0728F	MWAT043R1	5	1	0			
61	45	0728F	MWAT043R1	5	2	0			
61	45	0728F	MWAT043R1	5	3	0		Mean	1.6
61	45	0728F	MWAT043R1	5	4	0		SD	1.7
61	45	0728F	MWAT043R1	5	5	0		n	5
61	45	0728F	MWAT043R1	5	6	0			
61	45	0728F	MWAT043R1	5	7	0			
61	45	0728F	MWAT043R1	5	8	0			
61	45	0728F	MWAT043R1	5	9	0			
61	45	0728F	MWAT043R1	5	10	0	0		
65	110	0729F	MWAT048R1	1	1	0			
65	110	0729F	MWAT048R1	1	2	0			
65	110	0729F	MWAT048R1	1	3	0			
65	110	0729F	MWAT048R1	1	4	0			
65	110	0729F	MWAT048R1	1	5	0			
65	110	0729F	MWAT048R1	1	6	0			
65	110	0729F	MWAT048R1	1	7	0			
65	110	0729F	MWAT048R1	1	8	1			
65	110	0729F	MWAT048R1	1	9	0			
65	110	0729F	MWAT048R1	1	10	2	3		
66	36	0729F	MWAT048R1	2	1	0			
66	36	0729F	MWAT048R1	2	2	0			
66	36	0729F	MWAT048R1	2	3	0			
66	36	0729F	MWAT048R1	2	4	0			
66	36	0729F	MWAT048R1	2	5	0			
66	36	0729F	MWAT048R1	2	6	0			
66	36	0729F	MWAT048R1	2	7	0			
66	36	0729F	MWAT048R1	2	8	0			
66	36	0729F	MWAT048R1	2	9	0			
66	36	0729F	MWAT048R1	2	10	0	0		
67	40	0729F	MWAT048R1	3	1	0			
67	40	0729F	MWAT048R1	3	2	0			
67	40	0729F	MWAT048R1	3	3	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
67	40	0729F	MWAT048R1	3	4	0			
67	40	0729F	MWAT048R1	3	5	0			
67	40	0729F	MWAT048R1	3	6	0			
67	40	0729F	MWAT048R1	3	7	0			
67	40	0729F	MWAT048R1	3	8	0			
67	40	0729F	MWAT048R1	3	9	0			
67	40	0729F	MWAT048R1	3	10	0	0		
68	88	0729F	MWAT048R1	4	1	0			
68	88	0729F	MWAT048R1	4	2	0			
68	88	0729F	MWAT048R1	4	3	0			
68	88	0729F	MWAT048R1	4	4	0			
68	88	0729F	MWAT048R1	4	5	0			
68	88	0729F	MWAT048R1	4	6	0			
68	88	0729F	MWAT048R1	4	7	0			
68	88	0729F	MWAT048R1	4	8	0			
68	88	0729F	MWAT048R1	4	9	0			
68	88	0729F	MWAT048R1	4	10	0	0		
69	84	0729F	MWAT048R1	5	1	0			
69	84	0729F	MWAT048R1	5	2	0			
69	84	0729F	MWAT048R1	5	3	1		Mean	3.4
69	84	0729F	MWAT048R1	5	4	0		SD	6.1
69	84	0729F	MWAT048R1	5	5	0		n	5
69	84	0729F	MWAT048R1	5	6	2			
69	84	0729F	MWAT048R1	5	7	4			
69	84	0729F	MWAT048R1	5	8	2			
69	84	0729F	MWAT048R1	5	9	2			
69	84	0729F	MWAT048R1	5	10	3	14		
73	75	0730F	MWAT052R1	1	1	0			
73	75	0730F	MWAT052R1	1	2	0			
73	75	0730F	MWAT052R1	1	3	1			
73	75	0730F	MWAT052R1	1	4	1			
73	75	0730F	MWAT052R1	1	5	0			
73	75	0730F	MWAT052R1	1	6	0			
73	75	0730F	MWAT052R1	1	7	1			
73	75	0730F	MWAT052R1	1	8	0			
73	75	0730F	MWAT052R1	1	9	0			
73	75	0730F	MWAT052R1	1	10	1	4		
74	78	0730F	MWAT052R1	2	1	0			
74	78	0730F	MWAT052R1	2	2	0			
74	78	0730F	MWAT052R1	2	3	0			
74	78	0730F	MWAT052R1	2	4	0			
74	78	0730F	MWAT052R1	2	5	0			
74	78	0730F	MWAT052R1	2	6	0			
74	78	0730F	MWAT052R1	2	7	0			
74	78	0730F	MWAT052R1	2	8	0			
74	78	0730F	MWAT052R1	2	9	0			
74	78	0730F	MWAT052R1	2	10	2	2		

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
75	47	0730F	MWAT052R1	3	1	1			
75	47	0730F	MWAT052R1	3	2	1			
75	47	0730F	MWAT052R1	3	3	0			
75	47	0730F	MWAT052R1	3	4	0			
75	47	0730F	MWAT052R1	3	5	0			
75	47	0730F	MWAT052R1	3	6	0			
75	47	0730F	MWAT052R1	3	7	0			
75	47	0730F	MWAT052R1	3	8	0			
75	47	0730F	MWAT052R1	3	9	0			
75	47	0730F	MWAT052R1	3	10	4	6		
76	79	0730F	MWAT052R1	4	1	0			
76	79	0730F	MWAT052R1	4	2	0			
76	79	0730F	MWAT052R1	4	3	0			
76	79	0730F	MWAT052R1	4	4	0			
76	79	0730F	MWAT052R1	4	5	0			
76	79	0730F	MWAT052R1	4	6	0			
76	79	0730F	MWAT052R1	4	7	0			
76	79	0730F	MWAT052R1	4	8	0			
76	79	0730F	MWAT052R1	4	9	2			
76	79	0730F	MWAT052R1	4	10	2	4		
77	13	0730F	MWAT052R1	5	1	0			
77	13	0730F	MWAT052R1	5	2	2			
77	13	0730F	MWAT052R1	5	3	1		Mean	4.4
77	13	0730F	MWAT052R1	5	4	0		SD	1.7
77	13	0730F	MWAT052R1	5	5	1		n	5
77	13	0730F	MWAT052R1	5	6	0			
77	13	0730F	MWAT052R1	5	7	0			
77	13	0730F	MWAT052R1	5	8	0			
77	13	0730F	MWAT052R1	5	9	0			
77	13	0730F	MWAT052R1	5	10	2	6		
81	32	0748F	control	1	1	1			
81	32	0748F	control	1	2	0			
81	32	0748F	control	1	3	0			
81	32	0748F	control	1	4	2			
81	32	0748F	control	1	5	0			
81	32	0748F	control	1	6	0			
81	32	0748F	control	1	7	2			
81	32	0748F	control	1	8	2			
81	32	0748F	control	1	9	2			
81	32	0748F	control	1	10	2	11		
82	22	0748F	control	2	1	0			
82	22	0748F	control	2	2	0			
82	22	0748F	control	2	3	0			
82	22	0748F	control	2	4	1			
82	22	0748F	control	2	5	1			
82	22	0748F	control	2	6	2			
82	22	0748F	control	2	7	1			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
82	22	0748F	control	2	8	1			
82	22	0748F	control	2	9	1			
82	22	0748F	control	2	10	1	8		
83	62	0748F	control	3	1	0			
83	62	0748F	control	3	2	0			
83	62	0748F	control	3	3	0			
83	62	0748F	control	3	4	0			
83	62	0748F	control	3	5	0			
83	62	0748F	control	3	6	0			
83	62	0748F	control	3	7	0			
83	62	0748F	control	3	8	0			
83	62	0748F	control	3	9	0			
83	62	0748F	control	3	10	0	0		
84	97	0748F	control	4	1	0			
84	97	0748F	control	4	2	0			
84	97	0748F	control	4	3	0			
84	97	0748F	control	4	4	1			
84	97	0748F	control	4	5	1			
84	97	0748F	control	4	6	0			
84	97	0748F	control	4	7	2			
84	97	0748F	control	4	8	2			
84	97	0748F	control	4	9	1			
84	97	0748F	control	4	10	2	9		
85	59	0748F	control	5	1	0			
85	59	0748F	control	5	2	0			
85	59	0748F	control	5	3	0		Mean	6.4
85	59	0748F	control	5	4	1		SD	4.4
85	59	0748F	control	5	5	0		n	5
85	59	0748F	control	5	6	0			
85	59	0748F	control	5	7	1			
85	59	0748F	control	5	8	0			
85	59	0748F	control	5	9	1			
85	59	0748F	control	5	10	1	4		
89	52	0749F	MWRC208R1	1	1	0			
89	52	0749F	MWRC208R1	1	2	0			
89	52	0749F	MWRC208R1	1	3	2			
89	52	0749F	MWRC208R1	1	4	2			
89	52	0749F	MWRC208R1	1	5	0			
89	52	0749F	MWRC208R1	1	6	0			
89	52	0749F	MWRC208R1	1	7	0			
89	52	0749F	MWRC208R1	1	8	2			
89	52	0749F	MWRC208R1	1	9	0			
89	52	0749F	MWRC208R1	1	10	1	7		
90	73	0749F	MWRC208R1	2	1	0			
90	73	0749F	MWRC208R1	2	2	0			
90	73	0749F	MWRC208R1	2	3	1			
90	73	0749F	MWRC208R1	2	4	1			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
90	73	0749F	MWRC208R1	2	5	0			
90	73	0749F	MWRC208R1	2	6	0			
90	73	0749F	MWRC208R1	2	7	2			
90	73	0749F	MWRC208R1	2	8	0			
90	73	0749F	MWRC208R1	2	9	1			
90	73	0749F	MWRC208R1	2	10	1	6		
91	109	0749F	MWRC208R1	3	1	0			
91	109	0749F	MWRC208R1	3	2	0			
91	109	0749F	MWRC208R1	3	3	0			
91	109	0749F	MWRC208R1	3	4	0			
91	109	0749F	MWRC208R1	3	5	0			
91	109	0749F	MWRC208R1	3	6	0			
91	109	0749F	MWRC208R1	3	7	0			
91	109	0749F	MWRC208R1	3	8	0			
91	109	0749F	MWRC208R1	3	9	0			
91	109	0749F	MWRC208R1	3	10	0	0		
92	46	0749F	MWRC208R1	4	1	0			
92	46	0749F	MWRC208R1	4	2	0			
92	46	0749F	MWRC208R1	4	3	0			
92	46	0749F	MWRC208R1	4	4	0			
92	46	0749F	MWRC208R1	4	5	0			
92	46	0749F	MWRC208R1	4	6	0			
92	46	0749F	MWRC208R1	4	7	0			
92	46	0749F	MWRC208R1	4	8	0			
92	46	0749F	MWRC208R1	4	9	0			
92	46	0749F	MWRC208R1	4	10	0	0		
93	107	0749F	MWRC208R1	5	1	0			
93	107	0749F	MWRC208R1	5	2	0			
93	107	0749F	MWRC208R1	5	3	0		Mean	3
93	107	0749F	MWRC208R1	5	4	0		SD	3.3
93	107	0749F	MWRC208R1	5	5	0		n	5
93	107	0749F	MWRC208R1	5	6	0			
93	107	0749F	MWRC208R1	5	7	0			
93	107	0749F	MWRC208R1	5	8	1			
93	107	0749F	MWRC208R1	5	9	0			
93	107	0749F	MWRC208R1	5	10	1	2		
97	112	0750F	MWRC209R1	1	1	0			
97	112	0750F	MWRC209R1	1	2	0			
97	112	0750F	MWRC209R1	1	3	2			
97	112	0750F	MWRC209R1	1	4	0			
97	112	0750F	MWRC209R1	1	5	0			
97	112	0750F	MWRC209R1	1	6	0			
97	112	0750F	MWRC209R1	1	7	0			
97	112	0750F	MWRC209R1	1	8	0			
97	112	0750F	MWRC209R1	1	9	0			
97	112	0750F	MWRC209R1	1	10	0	2		
98	94	0750F	MWRC209R1	2	1	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
98	94	0750F	MWRC209R1	2	2	0			
98	94	0750F	MWRC209R1	2	3	1			
98	94	0750F	MWRC209R1	2	4	1			
98	94	0750F	MWRC209R1	2	5	0			
98	94	0750F	MWRC209R1	2	6	0			
98	94	0750F	MWRC209R1	2	7	0			
98	94	0750F	MWRC209R1	2	8	0			
98	94	0750F	MWRC209R1	2	9	1			
98	94	0750F	MWRC209R1	2	10	0	3		
99	80	0750F	MWRC209R1	3	1	0			
99	80	0750F	MWRC209R1	3	2	0			
99	80	0750F	MWRC209R1	3	3	0			
99	80	0750F	MWRC209R1	3	4	0			
99	80	0750F	MWRC209R1	3	5	0			
99	80	0750F	MWRC209R1	3	6	0			
99	80	0750F	MWRC209R1	3	7	0			
99	80	0750F	MWRC209R1	3	8	0			
99	80	0750F	MWRC209R1	3	9	0			
99	80	0750F	MWRC209R1	3	10	0	0		
100	85	0750F	MWRC209R1	4	1	0			
100	85	0750F	MWRC209R1	4	2	0			
100	85	0750F	MWRC209R1	4	3	0			
100	85	0750F	MWRC209R1	4	4	1			
100	85	0750F	MWRC209R1	4	5	0			
100	85	0750F	MWRC209R1	4	6	0			
100	85	0750F	MWRC209R1	4	7	0			
100	85	0750F	MWRC209R1	4	8	0			
100	85	0750F	MWRC209R1	4	9	0			
100	85	0750F	MWRC209R1	4	10	2	3		
101	9	0750F	MWRC209R1	5	1	0			
101	9	0750F	MWRC209R1	5	2	0			
101	9	0750F	MWRC209R1	5	3	0		Mean	1.8
101	9	0750F	MWRC209R1	5	4	1		SD	1.3
101	9	0750F	MWRC209R1	5	5	0		n	5
101	9	0750F	MWRC209R1	5	6	0			
101	9	0750F	MWRC209R1	5	7	0			
101	9	0750F	MWRC209R1	5	8	0			
101	9	0750F	MWRC209R1	5	9	0			
101	9	0750F	MWRC209R1	5	10	0	1		
105	23	0751F	MWRC210R1	1	1	0			
105	23	0751F	MWRC210R1	1	2	0			
105	23	0751F	MWRC210R1	1	3	0			
105	23	0751F	MWRC210R1	1	4	0			
105	23	0751F	MWRC210R1	1	5	1			
105	23	0751F	MWRC210R1	1	6	0			
105	23	0751F	MWRC210R1	1	7	0			
105	23	0751F	MWRC210R1	1	8	0			

Emergence Data

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	EMERG	TOTAL EMERG		
105	23	0751F	MWRC210R1	1	9	0			
105	23	0751F	MWRC210R1	1	10	0	1		
106	16	0751F	MWRC210R1	2	1	0			
106	16	0751F	MWRC210R1	2	2	0			
106	16	0751F	MWRC210R1	2	3	1			
106	16	0751F	MWRC210R1	2	4	1			
106	16	0751F	MWRC210R1	2	5	0			
106	16	0751F	MWRC210R1	2	6	1			
106	16	0751F	MWRC210R1	2	7	2			
106	16	0751F	MWRC210R1	2	8	3			
106	16	0751F	MWRC210R1	2	9	2			
106	16	0751F	MWRC210R1	2	10	3	13		
107	65	0751F	MWRC210R1	3	1	0			
107	65	0751F	MWRC210R1	3	2	0			
107	65	0751F	MWRC210R1	3	3	0			
107	65	0751F	MWRC210R1	3	4	0			
107	65	0751F	MWRC210R1	3	5	0			
107	65	0751F	MWRC210R1	3	6	0			
107	65	0751F	MWRC210R1	3	7	0			
107	65	0751F	MWRC210R1	3	8	1			
107	65	0751F	MWRC210R1	3	9	0			
107	65	0751F	MWRC210R1	3	10	0	1		
108	4	0751F	MWRC210R1	4	1	0			
108	4	0751F	MWRC210R1	4	2	0			
108	4	0751F	MWRC210R1	4	3	0			
108	4	0751F	MWRC210R1	4	4	1			
108	4	0751F	MWRC210R1	4	5	1			
108	4	0751F	MWRC210R1	4	6	0			
108	4	0751F	MWRC210R1	4	7	0			
108	4	0751F	MWRC210R1	4	8	1			
108	4	0751F	MWRC210R1	4	9	1			
108	4	0751F	MWRC210R1	4	10	0	4		
109	106	0751F	MWRC210R1	5	1	0			
109	106	0751F	MWRC210R1	5	2	0			
109	106	0751F	MWRC210R1	5	3	0		Mean	4
109	106	0751F	MWRC210R1	5	4	0		SD	5.2
109	106	0751F	MWRC210R1	5	5	0		n	5
109	106	0751F	MWRC210R1	5	6	0			
109	106	0751F	MWRC210R1	5	7	0			
109	106	0751F	MWRC210R1	5	8	0			
109	106	0751F	MWRC210R1	5	9	0			
109	106	0751F	MWRC210R1	5	10	1	1		

Marine Amphipod Test - *Rhepoxynius abronius*
Water Quality Data (Overlying Water)

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3
4	0751F	MWRC210R1	4	0	15.5	8.0	28.0	7.8		
6	0723F	MWAT054R1	6	0	15.0	8.0	27.0	7.8	<0.01	0.7
7	0690F	MWAS022R1	1	0	15.4	8.0	28.0	7.8		
8	0690F	MWAS022R1	2	0	15.4	8.0	28.0	7.9		
9	0750F	MWRC209R1	5	0	15.3	8.0	28.0	8.0		
11	0721F	MWAT040R1	3	0	15.4	8.1	28.0	8.0		
12	0749F	MWRC208R1	6	0	15.4	8.1	29.0	7.9	<0.01	2.1
13	0730F	MWAT052R1	5	0	15.5	8.1	28.0	7.7		
15	0722F	MWAT049R1	4	0	15.4	8.0	28.0	7.9		
16	0751F	MWRC210R1	2	0	15.5	8.0	28.5	8.0		
17	0723F	MWAT054R1	3	0	15.4	8.0	28.5	7.9		
18	0721F	MWAT040R1	4	0	15.4	8.0	28.0	8.0		
19	0722F	MWAT049R1	1	0	15.5	8.1	28.0	7.9		
20	0729F	MWAT048R1	6	0	15.4	8.0	27.0	8.0	<0.01	0.8
21	0751F	MWRC210R1	6	0	15.5	8.0	28.0	8.0	<0.01	2.0
22	0748F	control	2	0	15.5	8.1	28.0	7.9		
23	0751F	MWRC210R1	1	0	15.6	8.1	27.0	7.7		
24	0722F	MWAT049R1	3	0	15.5	7.9	27.0	8.0		
25	0690F	MWAS022R1	4	0	15.6	8.0	28.0	7.9		
26	0728F	MWAT043R1	2	0	15.5	8.0	28.0	8.0		
28	0690F	MWAS022R1	5	0	15.6	8.1	28.0	8.0		
30	0721F	MWAT040R1	2	0	15.6	8.1	28.0	8.0		
31	0722F	MWAT049R1	6	0	15.6	8.1	28.0	8.0	<0.01	0.5
32	0748F	control	1	0	15.6	8.1	28.0	8.0		
34	0727F	MWAT039R1	3	0	15.7	8.0	27.0	7.9		
35	0692F	MWAS025R1	2	0	15.5	8.1	27.0	8.0		
36	0729F	MWAT048R1	2	0	15.4	8.1	29.0	8.0		
37	0721F	MWAT040R1	5	0	15.5	8.1	27.0	8.0		
38	0723F	MWAT054R1	4	0	15.5	8.0	28.0	8.0		
39	0692F	MWAS025R1	6	0	15.6	8.0	28.0	7.9	<0.01	1.2
40	0729F	MWAT048R1	3	0	15.6	8.1	28.0	7.9		
42	0722F	MWAT049R1	5	0	15.6	8.0	27.0	8.0		
43	0723F	MWAT054R1	1	0	15.7	8.0	28.0	8.0		
45	0728F	MWAT043R1	5	0	15.7	8.0	28.5	7.8		
46	0749F	MWRC208R1	4	0	15.7	8.0	28.0	7.9		
47	0730F	MWAT052R1	3	0	15.6	7.8	28.0	7.9		
48	0691F	MWAS024R1	2	0	15.7	7.9	28.0	7.9		
50	0727F	MWAT039R1	6	0	15.5	8.0	27.5	8.0	<0.01	1.3
51	0727F	MWAT039R1	1	0	15.5	8.0	28.0	8.1		
52	0749F	MWRC208R1	1	0	15.6	8.1	28.0	8.1		
54	0721F	MWAT040R1	1	0	15.6	8.1	29.0	8.0		
55	0692F	MWAS025R1	3	0	15.7	8.1	29.0	8.0		
56	0727F	MWAT039R1	5	0	15.6	8.0	28.0	8.0		
58	0723F	MWAT054R1	5	0	15.6	8.0	28.0	8.0		
59	0748F	control	5	0	15.5	8.0	28.0	8.0		
61	0750F	MWRC209R1	6	0	15.7	8.1	28.0	8.0	<0.01	2.3
62	0748F	control	3	0	15.5	8.0	28.5	8.0		
63	0690F	MWAS022R1	3	0	15.5	8.1	27.5	8.0		
64	0692F	MWAS025R1	5	0	15.7	8.1	28.0	8.0		
65	0751F	MWRC210R1	3	0	15.5	8.0	27.0	8.1		
66	0730F	MWAT052R1	6	0	15.5	8.0	27.0	8.1	<0.01	1.4
67	0728F	MWAT043R1	1	0	15.7	8.1	27.0	8.0		
69	0691F	MWAS024R1	4	0	15.6	8.2	28.0	8.0		
71	0728F	MWAT043R1	4	0	15.5	8.1	28.0	8.0		
72	0721F	MWAT040R1	6	0	15.5	8.1	29.0	8.0	<0.01	1.0
73	0749F	MWRC208R1	2	0	15.7	7.6	28.0	7.9		
75	0730F	MWAT052R1	1	0	15.3	8.0	28.0	8.1		
76	0727F	MWAT039R1	4	0	15.6	7.2	28.0	7.7		
77	0691F	MWAS024R1	6	0	15.4	8.0	28.0	8.1	<0.01	1.4
78	0730F	MWAT052R1	2	0	15.6	8.1	27.0	7.9		
79	0730F	MWAT052R1	4	0	15.5	8.1	27.0	8.1		
80	0750F	MWRC209R1	3	0	15.4	8.1	28.0	8.2		
84	0729F	MWAT048R1	5	0	15.4	8.2	27.0	8.0		
85	0750F	MWRC209R1	4	0	15.6	8.2	28.0	8.1		
86	0691F	MWAS024R1	5	0	15.6	8.0	28.0	7.9		
88	0729F	MWAT048R1	4	0	15.6	7.8	27.0	8.0		
89	0723F	MWAT054R1	2	0	15.4	8.0	28.0	8.0		
91	0728F	MWAT043R1	6	0	15.7	7.2	28.0	7.9	<0.01	1.0

Data entry verified against laboratory bench sheets
MSR
7-17-98

Water Quality Data (Overlying Water)

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3
92	0691F	MWAS024R1	3	0	15.5	7.9	28.0	8.0		
93	0692F	MWAS025R1	4	0	15.3	8.1	28.0	8.1		
94	0750F	MWRC209R1	2	0	15.6	7.8	29.0	8.1		
96	0728F	MWAT043R1	3	0	15.5	8.0	28.0	8.1		
97	0748F	control	4	0	15.7	8.1	28.0	8.0		
98	0727F	MWAT039R1	2	0	15.5	8.0	28.0	8.0		
99	0692F	MWAS025R1	1	0	15.4	8.0	28.0	8.1		
100	0691F	MWAS024R1	1	0	15.8	7.3	28.0	7.9		
102	0722F	MWAT049R1	2	0	15.7	7.6	28.0	7.8		
103	0690F	MWAS022R1	6	0	15.8	7.8	28.0	8.0	<0.01	0.6
105	0748F	control	6	0	15.7	8.0	28.0	8.0	<0.01	0.3
106	0751F	MWRC210R1	5	0	15.8	8.0	29.0	8.0		
107	0749F	MWRC208R1	5	0	15.7	7.9	28.0	8.0		
109	0749F	MWRC208R1	3	0	15.8	8.0	28.0	8.1		
110	0729F	MWAT048R1	1	0	15.6	7.8	28.0	8.0		
112	0750F	MWRC209R1	1	0	15.8	7.8	29.0	8.0		
6	0723F	MWAT054R1	6	1	15.2	8.0	28.0	7.3		
12	0749F	MWRC208R1	6	1	15.0	8.0	28.0	7.7		
20	0729F	MWAT048R1	6	1	15.0	8.0	28.0	7.8		
21	0751F	MWRC210R1	6	1	14.9	8.1	28.0	7.8		
31	0722F	MWAT049R1	6	1	15.0	8.0	28.0	7.8		
39	0692F	MWAS025R1	6	1	14.8	8.0	28.0	7.9		
50	0727F	MWAT039R1	6	1	14.9	8.0	28.0	7.9		
61	0750F	MWRC209R1	6	1	15.0	8.1	28.0	7.9		
66	0730F	MWAT052R1	6	1	14.8	8.1	28.0	8.0		
72	0721F	MWAT040R1	6	1	14.8	8.0	28.0	8.0		
77	0691F	MWAS024R1	6	1	14.8	8.0	28.5	8.1		
91	0728F	MWAT043R1	6	1	14.9	8.0	28.0	8.0		
103	0690F	MWAS022R1	6	1	15.1	8.1	28.0	8.0		
105	0748F	control	6	1	15.0	8.1	28.0	7.9		
6	0723F	MWAT054R1	6	2	15.0	7.5	27.0	7.3		
12	0749F	MWRC208R1	6	2	14.9	7.8	27.0	7.7		
20	0729F	MWAT048R1	6	2	15.0	7.8	27.0	7.7		
21	0751F	MWRC210R1	6	2	15.0	7.8	27.0	7.9		
31	0722F	MWAT049R1	6	2	15.0	7.7	27.0	7.9		
37	0721F	MWAT040R1	5	2		7.8				
38	0723F	MWAT054R1	4	2		7.8				
39	0692F	MWAS025R1	6	2	15.0	7.7	27.0	8.0		
40	0729F	MWAT048R1	3	2		7.8				
42	0722F	MWAT049R1	5	2		7.7				
43	0723F	MWAT054R1	1	2		7.8				
45	0728F	MWAT043R1	5	2		7.6				
46	0749F	MWRC208R1	4	2		7.8				
47	0730F	MWAT052R1	3	2		7.8				
48	0691F	MWAS024R1	2	2		7.8				
50	0727F	MWAT039R1	6	2	15.0	7.4	27.0	7.8		
51	0727F	MWAT039R1	1	2		7.6				
52	0749F	MWRC208R1	1	2		7.8				
54	0721F	MWAT040R1	1	2		7.8				
55	0692F	MWAS025R1	3	2		7.5				
61	0750F	MWRC209R1	6	2	15.1	7.5	27.0	7.9		
66	0730F	MWAT052R1	6	2	15.0	7.7	26.5	8.0		
72	0721F	MWAT040R1	6	2	15.0	7.5	28.0	8.0		
73	0749F	MWRC208R1	2	2		7.6				
77	0691F	MWAS024R1	6	2	14.9	7.7	28.0	8.1		
91	0728F	MWAT043R1	6	2	15.0	7.5	27.5	8.0		
100	0691F	MWAS024R1	1	2		7.6				
102	0722F	MWAT049R1	2	2		7.8				
103	0690F	MWAS022R1	6	2	15.1	7.6	28.0	7.7		
105	0748F	control	6	2	15.0	7.2	28.0	7.7		
106	0751F	MWRC210R1	5	2		7.4				
107	0749F	MWRC208R1	5	2		7.8				
109	0749F	MWRC208R1	3	2		7.8				
110	0729F	MWAT048R1	1	2		7.5				
112	0750F	MWRC209R1	1	2		7.5				
6	0723F	MWAT054R1	6	3	15.1	7.9	27.5	7.6		
12	0749F	MWRC208R1	6	3	15.0	7.8	27.5	7.9		
20	0729F	MWAT048R1	6	3	15.1	7.9	27.0	7.8		

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3
21	0751F	MWRC210R1	6	3	15.1	7.9	27.0	7.9		
31	0722F	MWAT049R1	6	3	15.1	8.0	27.5	7.9		
39	0692F	MWAS025R1	6	3	15.2	8.0	28.0	8.0		
50	0727F	MWAT039R1	6	3	15.1	7.9	27.0	7.7		
61	0750F	MWRC209R1	6	3	15.2	7.7	27.5	8.0		
66	0730F	MWAT052R1	6	3	15.3	7.8	27.0	8.0		
72	0721F	MWAT040R1	6	3	15.2	7.9	28.5	7.9		
77	0691F	MWAS024R1	6	3	15.1	8.0	29.0	8.1		
91	0728F	MWAT043R1	6	3	15.1	8.0	28.5	8.1		
103	0690F	MWAS022R1	6	3	15.2	8.0	29.0	8.0		
105	0748F	control	6	3	15.1	8.0	29.0	8.1		
6	0723F	MWAT054R1	6	4	15.0	7.8	27.0	7.7		
12	0749F	MWRC208R1	6	4	15.0	7.7	27.0	8.0		
20	0729F	MWAT048R1	6	4	15.1	7.8	27.0	8.0		
21	0751F	MWRC210R1	6	4	15.0	7.9	28.0	8.1		
31	0722F	MWAT049R1	6	4	15.2	8.0	28.0	8.1		
39	0692F	MWAS025R1	6	4	15.1	8.0	28.0	8.1		
50	0727F	MWAT039R1	6	4	15.1	7.9	27.0	8.0		
61	0750F	MWRC209R1	6	4	15.2	8.0	27.0	8.1		
66	0730F	MWAT052R1	6	4	15.2	8.0	27.0	8.1		
72	0721F	MWAT040R1	6	4	15.2	8.0	27.0	8.1		
77	0691F	MWAS024R1	6	4	15.1	8.0	28.0	8.2		
91	0728F	MWAT043R1	6	4	15.2	8.0	28.0	8.0		
103	0690F	MWAS022R1	6	4	15.3	7.7	29.0	7.9		
105	0748F	control	6	4	15.0	7.6	29.0	8.1		
6	0723F	MWAT054R1	6	5	15.0	8.2	27.0	7.4		
12	0749F	MWRC208R1	6	5	15.0	8.2	27.0	7.9		
20	0729F	MWAT048R1	6	5	15.0	8.1	27.0	7.8		
21	0751F	MWRC210R1	6	5	15.0	8.2	27.0	7.9		
31	0722F	MWAT049R1	6	5	15.1	8.2	27.0	8.0		
39	0692F	MWAS025R1	6	5	15.0	8.2	27.0	8.1		
50	0727F	MWAT039R1	6	5	15.1	8.3	27.0	7.8		
61	0750F	MWRC209R1	6	5	15.2	8.1	27.0	8.0		
66	0730F	MWAT052R1	6	5	15.1	8.0	27.0	8.1		
72	0721F	MWAT040R1	6	5	15.1	8.2	28.5	8.0		
77	0691F	MWAS024R1	6	5	15.1	8.2	29.0	8.1		
91	0728F	MWAT043R1	6	5	15.1	8.2	28.0	8.0		
103	0690F	MWAS022R1	6	5	15.2	8.2	29.0	7.8		
105	0748F	control	6	5	15.0	8.0	29.0	8.0		
6	0723F	MWAT054R1	6	6	15.1	7.6	28.5	7.7		
12	0749F	MWRC208R1	6	6	15.1	7.6	28.5	8.1		
20	0729F	MWAT048R1	6	6	15.1	7.8	29.0	8.0		
21	0751F	MWRC210R1	6	6	15.1	7.8	29.0	8.0		
31	0722F	MWAT049R1	6	6	15.2	7.9	29.0	8.1		
39	0692F	MWAS025R1	6	6	15.2	7.8	28.5	8.2		
50	0727F	MWAT039R1	6	6	15.2	7.8	29.0	7.9		
61	0750F	MWRC209R1	6	6	15.3	7.7	29.0	8.1		
66	0730F	MWAT052R1	6	6	15.3	7.8	29.0	8.1		
72	0721F	MWAT040R1	6	6	15.3	7.8	29.0	8.0		
77	0691F	MWAS024R1	6	6	15.3	7.9	28.5	8.1		
91	0728F	MWAT043R1	6	6	15.2	7.9	29.0	8.0		
103	0690F	MWAS022R1	6	6	15.3	8.0	29.0	7.8		
105	0748F	control	6	6	15.2	7.7	29.0	8.1		
6	0723F	MWAT054R1	6	7	15.2	7.6	28.0	7.8		
12	0749F	MWRC208R1	6	7	15.2	7.8	28.0	8.2		
20	0729F	MWAT048R1	6	7	15.1	7.8	27.0	8.1		
21	0751F	MWRC210R1	6	7	15.1	7.8	27.0	8.1		
31	0722F	MWAT049R1	6	7	15.1	7.8	27.0	8.2		
39	0692F	MWAS025R1	6	7	15.1	7.8	27.0	8.2		
50	0727F	MWAT039R1	6	7	15.2	7.8	27.0	7.9		
61	0750F	MWRC209R1	6	7	15.1	7.8	27.0	8.1		
66	0730F	MWAT052R1	6	7	15.1	7.8	27.0	8.1		
72	0721F	MWAT040R1	6	7	15.1	7.8	27.0	8.1		
77	0691F	MWAS024R1	6	7	15.1	7.8	27.0	8.2		
91	0728F	MWAT043R1	6	7	15.1	7.8	29.0	8.1		
103	0690F	MWAS022R1	6	7	15.1	7.6	29.0	7.8		
105	0748F	control	6	7	15.1	7.6	29.0	8.1		
6	0723F	MWAT054R1	6	8	15.1	8.0	28.0	7.7		

Marine Amphipod Test - *Rhepoxynius abronius*
Water Quality Data (Overlying Water)

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3
12	0749F	MWRC208R1	6	8	15.1	7.9	28.0	8.0		
20	0729F	MWAT048R1	6	8	15.1	7.9	28.0	8.1		
21	0751F	MWRC210R1	6	8	15.1	7.9	28.0	8.1		
31	0722F	MWAT049R1	6	8	15.1	8.0	28.0	8.0		
39	0692F	MWAS025R1	6	8	15.1	8.2	27.0	8.2		
50	0727F	MWAT039R1	6	8	15.0	8.0	27.0	7.9		
61	0750F	MWRC209R1	6	8	15.1	8.0	27.0	8.1		
66	0730F	MWAT052R1	6	8	15.1	8.0	27.0	8.2		
72	0721F	MWAT040R1	6	8	15.1	8.0	27.0	8.0		
77	0691F	MWAS024R1	6	8	15.1	8.0	28.0	8.2		
91	0728F	MWAT043R1	6	8	15.1	8.1	28.0	8.1		
103	0690F	MWAS022R1	6	8	15.1	8.1	29.0	7.9		
105	0748F	control	6	8	15.1	8.1	29.0	8.0		
6	0723F	MWAT054R1	6	9	15.0	8.0	29.0	7.7		
12	0749F	MWRC208R1	6	9	15.0	8.0	29.0	8.2		
20	0729F	MWAT048R1	6	9	15.0	8.0	28.0	8.1		
21	0751F	MWRC210R1	6	9	15.0	8.0	28.0	8.1		
31	0722F	MWAT049R1	6	9	15.0	8.0	28.0	8.2		
39	0692F	MWAS025R1	6	9	15.0	8.0	28.0	8.3		
50	0727F	MWAT039R1	6	9	15.0	8.0	27.0	8.0		
61	0750F	MWRC209R1	6	9	15.1	8.0	27.0	8.1		
66	0730F	MWAT052R1	6	9	15.1	8.0	28.0	8.2		
72	0721F	MWAT040R1	6	9	15.1	8.0	28.0	8.1		
77	0691F	MWAS024R1	6	9	15.1	8.0	28.0	8.0		
91	0728F	MWAT043R1	6	9	15.1	8.0	28.0	8.1		
103	0690F	MWAS022R1	6	9	15.1	8.0	29.0	7.9		
105	0748F	control	6	9	15.1	8.0	29.0	8.1		
4	0751F	MWRC210R1	4	10	15.3	7.7	29.0	7.9		
6	0723F	MWAT054R1	6	10	15.2	7.3	28.0	7.8	<0.01	1.1
7	0690F	MWAS022R1	1	10	15.2	7.4	28.5	7.7		
8	0690F	MWAS022R1	2	10	15.1	7.4	29.0	7.7		
9	0750F	MWRC209R1	5	10	15.0	7.6	29.0	8.1		
11	0721F	MWAT040R1	3	10	15.0	7.7	29.0	8.1		
12	0749F	MWRC208R1	6	10	15.0	7.7	29.0	8.2	<0.01	3.2
13	0730F	MWAT052R1	5	10	15.0	7.7	28.0	8.0		
15	0722F	MWAT049R1	4	10	15.0	7.5	28.0	8.2		
16	0751F	MWRC210R1	2	10	15.0	7.6	28.0	8.2		
17	0723F	MWAT054R1	3	10	15.0	7.6	28.0	7.9		
18	0721F	MWAT040R1	4	10	15.0	7.7	28.0	8.0		
19	0722F	MWAT049R1	1	10	15.0	7.7	28.0	8.2		
20	0729F	MWAT048R1	6	10	15.0	7.6	28.0	8.1	<0.01	<0.2
21	0751F	MWRC210R1	6	10	15.0	7.7	28.0	8.1	<0.01	0.2
22	0748F	control	2	10	15.0	7.7	28.0	8.0		
23	0751F	MWRC210R1	1	10	15.0	7.7	28.0	8.0		
24	0722F	MWAT049R1	3	10	15.0	7.7	28.0	8.2		
25	0690F	MWAS022R1	4	10	15.0	7.7	29.0	8.1		
26	0728F	MWAT043R1	2	10	15.0	7.7	28.0	8.2		
28	0690F	MWAS022R1	5	10	14.9	7.8	29.0	8.0		
30	0721F	MWAT040R1	2	10	14.9	7.8	29.0	7.9		
31	0722F	MWAT049R1	6	10	15.0	7.8	28.5	8.3	<0.01	0.4
32	0748F	control	1	10	15.0	7.7	29.0	8.2		
34	0727F	MWAT039R1	3	10	15.0	7.8	28.0	8.1		
35	0692F	MWAS025R1	2	10	15.0	7.7	29.0	8.3		
36	0729F	MWAT048R1	2	10	14.9	7.7	29.0	8.1		
37	0721F	MWAT040R1	5	10	14.9	7.8	29.0	8.1		
38	0723F	MWAT054R1	4	10	15.0	7.8	28.0	7.9		
39	0692F	MWAS025R1	6	10	14.9	7.8	29.0	8.3	<0.01	0.5
40	0729F	MWAT048R1	3	10	14.9	7.8	29.0	8.2		
42	0722F	MWAT049R1	5	10	15.0	7.8	29.0	8.4		
43	0723F	MWAT054R1	1	10	14.7	7.9	28.0	8.0		
45	0728F	MWAT043R1	5	10	15.0	7.9	28.0	8.0		
46	0749F	MWRC208R1	4	10	14.9	7.8	28.0	8.2		
47	0730F	MWAT052R1	3	10	15.0	7.8	28.0	8.3		
48	0691F	MWAS024R1	2	10	15.0	7.8	29.0	8.4		
50	0727F	MWAT039R1	6	10	15.0	7.8	28.0	8.1	<0.01	1.7
51	0727F	MWAT039R1	1	10	15.0	7.6	29.0	8.1		
52	0749F	MWRC208R1	1	10	15.0	7.6	29.0	8.3		
54	0721F	MWAT040R1	1	10	15.0	7.7	28.0	8.2		

Marine Amphipod Test - *Rhepoxynius abronius*
Water Quality Data (Overlying Water)

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3
55	0692F	MWAS025R1	3	10	15.0	7.8	29.0	8.3		
56	0727F	MWAT039R1	5	10	15.0	7.7	28.0	8.3		
58	0723F	MWAT054R1	5	10	15.0	7.6	29.0	8.0		
59	0748F	control	5	10	15.0	7.7	28.0	8.0		
61	0750F	MWRC209R1	6	10	15.1	7.8	28.0	8.3	<0.01	2.6
62	0748F	control	3	10	15.0	7.7	29.0	8.2		
63	0690F	MWAS022R1	3	10	15.0	7.8	29.0	8.0		
64	0692F	MWAS025R1	5	10	15.0	7.8	30.0	8.3		
65	0751F	MWRC210R1	3	10	15.0	7.7	28.0	8.2		
66	0730F	MWAT052R1	6	10	15.0	7.6	28.0	8.2	<0.01	1.7
67	0728F	MWAT043R1	1	10	15.0	7.7	29.0	8.2		
69	0691F	MWAS024R1	4	10	15.0	7.8	29.0	8.3		
71	0728F	MWAT043R1	4	10	15.0	7.8	29.0	8.1		
72	0721F	MWAT040R1	6	10	15.1	7.8	29.0	8.1	<0.01	<0.2
73	0749F	MWRC208R1	2	10	15.0	7.8	29.0	8.4		
75	0730F	MWAT052R1	1	10	15.1	7.7	28.0	8.3		
76	0727F	MWAT039R1	4	10	15.1	7.7	29.0	8.1		
77	0691F	MWAS024R1	6	10	15.0	7.6	29.0	8.3	<0.01	1.3
78	0730F	MWAT052R1	2	10	15.0	7.6	28.0	8.2		
79	0730F	MWAT052R1	4	10	15.0	7.5	28.0	8.2		
80	0750F	MWRC209R1	3	10	15.0	7.6	29.0	8.4		
84	0729F	MWAT048R1	5	10	15.0	7.7	29.0	8.2		
85	0750F	MWRC209R1	4	10	15.0	7.9	29.0	8.3		
86	0691F	MWAS024R1	5	10	15.0	7.8	29.0	8.3		
88	0729F	MWAT048R1	4	10	15.0	7.9	30.0	8.2		
89	0723F	MWAT054R1	2	10	15.0	7.8	30.0	8.0		
91	0728F	MWAT043R1	6	10	15.0	7.8	29.0	8.0	<0.01	<0.2
92	0691F	MWAS024R1	3	10	15.0	7.8	29.0	8.3		
93	0692F	MWAS025R1	4	10	15.0	7.8	29.0	8.4		
94	0750F	MWRC209R1	2	10	15.0	7.8	29.0	8.4		
96	0728F	MWAT043R1	3	10	15.1	7.8	29.0	8.3		
97	0748F	control	4	10	15.0	7.8	29.0	8.1		
98	0727F	MWAT039R1	2	10	15.1	7.8	29.0	8.1		
99	0692F	MWAS025R1	1	10	15.0	7.8	29.0	8.3		
100	0691F	MWAS024R1	1	10	15.1	8.0	29.0	8.7		
102	0722F	MWAT049R1	2	10	15.0	8.0	29.0	8.4		
103	0690F	MWAS022R1	6	10	15.0	7.7	29.0	7.9	<0.01	0.6
105	0748F	control	6	10	15.0	7.6	29.0	8.1	<0.01	<0.2
106	0751F	MWRC210R1	5	10	14.9	8.1	29.0	8.7		
107	0749F	MWRC208R1	5	10	15.1	8.2	29.0	8.6		
109	0749F	MWRC208R1	3	10	15.1	8.2	29.0	8.5		
110	0729F	MWAT048R1	1	10	15.1	8.1	29.0	8.2		
112	0750F	MWRC209R1	1	10	15.1	8.1	29.0	8.6		
				Mean	15.2	7.9	28.1	8.0	–	–
				SD	0.3	0.2	0.7	0.2	–	–
				n	294	315	294	294	28	28
				Max	15.8	8.3	30.0	8.7	<0.01	3.2
				Min	14.7	7.2	26.5	7.3	<0.01	<0.2

Amphipod Sediment-Survival

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	1.0000	1.0000	1.0000	0.9500	0.9000
MWRC208R1	0.9000	0.9500	1.0000	0.9500	0.9500
MWAS022R1	0.9500	0.8500	0.9500	0.9500	0.9500
MWAS024R1	0.9000	0.9000	0.8000	0.7000	0.8000
MWAS025R1	0.8000	1.0000	0.8500	0.9500	0.8500
MWAT040R1	0.9000	0.9500	0.9500	1.0000	1.0000
MWAT049R1	1.0000	0.9000	1.0000	1.0000	0.9000
MWAT054R1	0.9000	0.8500	0.9500	0.9500	0.9000
MWAT039R1	0.9500	0.9000	0.9500	0.9500	0.9500
MWAT043R1	0.9500	0.9000	1.0000	0.9000	1.0000
MWAT048R1	0.8000	1.0000	0.9500	0.8000	0.9500
MWAT052R1	0.9000	1.0000	0.8500	0.9500	1.0000
CONTROL	0.9500	1.0000	1.0000	1.0000	1.0000
MWRC210R1	0.9500	0.9000	1.0000	0.9500	0.9000

Comparisons made to MWRC208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	0.9700	1.0211	1.3941	1.2490	1.4588	6.802	5			
MWRC208R1	0.9500	1.0000	1.3487	1.2490	1.4588	5.509	5			
MWAS022R1	0.9300	0.9789	1.3108	1.1731	1.3453	5.874	5	0.792	1.860	0.0043
* MWAS024R1	0.8200	0.8632	1.1407	0.9912	1.2490	9.612	5	3.512	1.860	0.0065
MWAS025R1	0.8900	0.9368	1.2515	1.1071	1.4588	11.640	5	1.330	1.860	0.0099
MWAT040R1	0.9600	1.0105	1.3714	1.2490	1.4588	6.481	5	-0.438	1.860	0.0050
MWAT049R1	0.9600	1.0105	1.3749	1.2490	1.4588	8.355	5	-0.427	1.860	0.0070
MWAT054R1	0.9100	0.9579	1.2724	1.1731	1.3453	5.772	5	1.635	1.860	0.0041
MWAT039R1	0.9400	0.9895	1.3260	1.2490	1.3453	3.246	5	0.591	1.860	0.0027
MWAT043R1	0.9500	1.0000	1.3522	1.2490	1.4588	7.760	5	-0.060	1.860	0.0061
MWAT048R1	0.9000	0.9474	1.2727	1.1071	1.4588	12.421	5	0.973	1.860	0.0113
MWAT052R1	0.9400	0.9895	1.3370	1.1731	1.4588	9.484	5	0.179	1.860	0.0080
CONTROL	0.9900	1.0421	1.4361	1.3453	1.4588	3.534	5	-2.170	1.860	0.0030
MWRC210R1	0.9400	0.9895	1.3295	1.2490	1.4588	6.530	5	0.377	1.860	0.0049

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.86898	1.035	-0.0689	-0.7681
Bartlett's Test indicates equal variances (p = 0.49)	11.4043	26.217		
The control means are not significantly different (p = 0.42)	0.84255	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

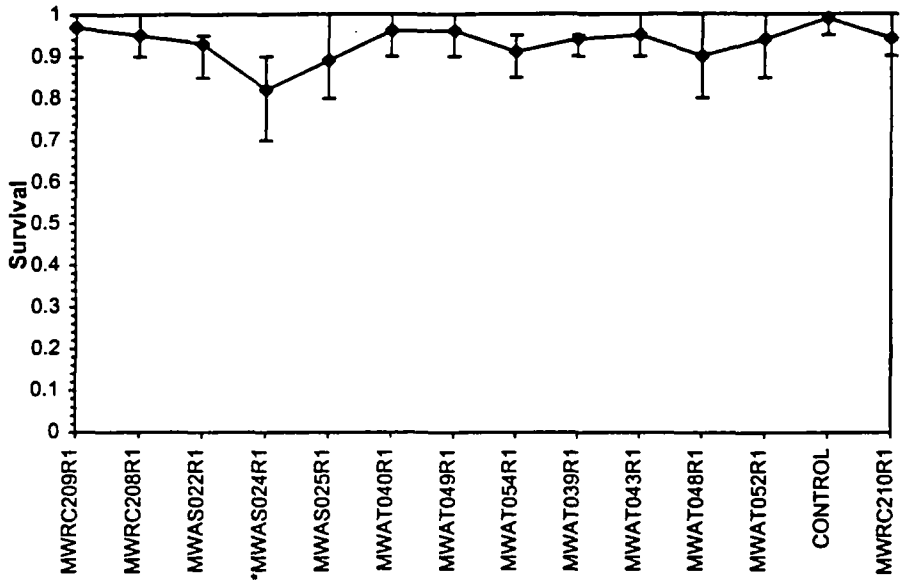
* significantly different from MWRC208R1

ToxCalc v5.0.15N

Amphipod Sediment Survival

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-Survival

Start Date:	5/29/98 13:00	Test ID:	590-1	~~Sample ID:~~	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	1.0000	1.0000	1.0000	0.9500	0.9000
MWRC208R1	0.9000	0.9500	1.0000	0.9500	0.9500
MWAS022R1	0.9500	0.8500	0.9500	0.9500	0.9500
MWAS024R1	0.9000	0.9000	0.8000	0.7000	0.8000
MWAS025R1	0.8000	1.0000	0.8500	0.9500	0.8500
MWAT040R1	0.9000	0.9500	0.9500	1.0000	1.0000
MWAT049R1	1.0000	0.9000	1.0000	1.0000	0.9000
MWAT054R1	0.9000	0.8500	0.9500	0.9500	0.9000
MWAT039R1	0.9500	0.9000	0.9500	0.9500	0.9500
MWAT043R1	0.9500	0.9000	1.0000	0.9000	1.0000
MWAT048R1	0.8000	1.0000	0.9500	0.8000	0.9500
MWAT052R1	0.9000	1.0000	0.8500	0.9500	1.0000
CONTROL	0.9500	1.0000	1.0000	1.0000	1.0000
MWRC210R1	0.9500	0.9000	1.0000	0.9500	0.9000

Comparison made to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	0.9700	1.0211	1.3941	1.2490	1.4588	6.802	5			
MWRC208R1	0.9500	1.0000	1.3487	1.2490	1.4588	5.509	5			
MWAS022R1	0.9300	0.9789	1.3108	1.1731	1.3453	5.874	5	1.524	1.860	0.0055
*MWAS024R1	0.8200	0.8632	1.1407	0.9912	1.2490	9.612	5	3.909	1.860	0.0078
MWAS025R1	0.8900	0.9368	1.2515	1.1071	1.4588	11.640	5	1.835	1.860	0.0112
MWAT040R1	0.9600	1.0105	1.3714	1.2490	1.4588	6.481	5	0.390	1.860	0.0063
MWAT049R1	0.9600	1.0105	1.3749	1.2490	1.4588	8.355	5	0.289	1.860	0.0083
*MWAT054R1	0.9100	0.9579	1.2724	1.1731	1.3453	5.772	5	2.270	1.860	0.0054
MWAT039R1	0.9400	0.9895	1.3260	1.2490	1.3453	3.246	5	1.462	1.860	0.0040
MWAT043R1	0.9500	1.0000	1.3522	1.2490	1.4588	7.760	5	0.663	1.860	0.0074
MWAT048R1	0.9000	0.9474	1.2727	1.1071	1.4588	12.421	5	1.473	1.860	0.0126
MWAT052R1	0.9400	0.9895	1.3370	1.1731	1.4588	9.484	5	0.807	1.860	0.0093
CONTROL	0.9900	1.0421	1.4361	1.3453	1.4588	3.534	5	-0.872	1.860	0.0043
MWRC210R1	0.9400	0.9895	1.3295	1.2490	1.4588	6.530	5	1.124	1.860	0.0061

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.98889	1.035	-0.1203	-0.8273
Bartlett's Test indicates equal variances (p = 0.54)	10.8229	26.217		
The control means are not significantly different (p = 0.42)	0.84255	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

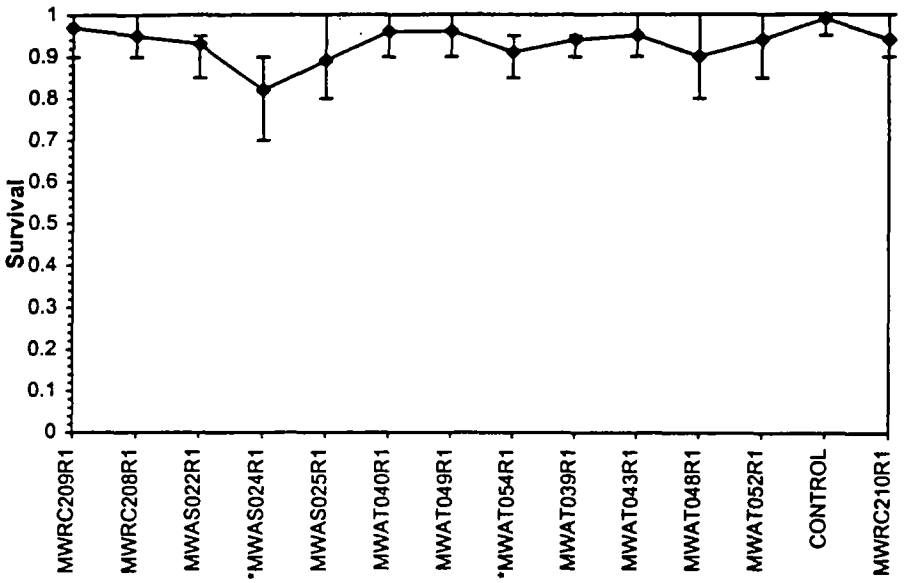
*Significantly different from MWRC209R1

ToxCalc v5.0.15N

Amphipod Sediment-Survival

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-Survival

Start Date:	5/29/98 13:00	Test ID:	590-1	~~Sample ID:~~	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC210R1	0.9500	0.9000	1.0000	0.9500	0.9000
MWRC208R1	0.9000	0.9500	1.0000	0.9500	0.9500
MWAS022R1	0.9500	0.8500	0.9500	0.9500	0.9500
MWAS024R1	0.9000	0.9000	0.8000	0.7000	0.8000
MWAS025R1	0.8000	1.0000	0.8500	0.9500	0.8500
MWAT040R1	0.9000	0.9500	0.9500	1.0000	1.0000
MWAT049R1	1.0000	0.9000	1.0000	1.0000	0.9000
MWAT054R1	0.9000	0.8500	0.9500	0.9500	0.9000
MWAT039R1	0.9500	0.9000	0.9500	0.9500	0.9500
MWAT043R1	0.9500	0.9000	1.0000	0.9000	1.0000
MWAT048R1	0.8000	1.0000	0.9500	0.8000	0.9500
MWAT052R1	0.9000	1.0000	0.8500	0.9500	1.0000
CONTROL	0.9500	1.0000	1.0000	1.0000	1.0000
MWRC209R1	1.0000	1.0000	1.0000	0.9500	0.9000

Comparison to MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC210R1	0.9400	0.9895	1.3295	1.2490	1.4588	6.530	5			
MWRC208R1	0.9500	1.0000	1.3487	1.2490	1.4588	5.509	5			
MWAS022R1	0.9300	0.9789	1.3108	1.1731	1.3453	5.874	5	0.359	1.860	0.0050
* MWAS024R1	0.8200	0.8632	1.1407	0.9912	1.2490	9.612	5	3.018	1.860	0.0073
MWAS025R1	0.8900	0.9368	1.2515	1.1071	1.4588	11.640	5	1.029	1.860	0.0107
MWAT040R1	0.9600	1.0105	1.3714	1.2490	1.4588	6.481	5	-0.755	1.860	0.0057
MWAT049R1	0.9600	1.0105	1.3749	1.2490	1.4588	8.355	5	-0.705	1.860	0.0077
MWAT054R1	0.9100	0.9579	1.2724	1.1731	1.3453	5.772	5	1.123	1.860	0.0048
MWAT039R1	0.9400	0.9895	1.3260	1.2490	1.3453	3.246	5	0.080	1.860	0.0035
MWAT043R1	0.9500	1.0000	1.3522	1.2490	1.4588	7.760	5	-0.373	1.860	0.0069
MWAT048R1	0.9000	0.9474	1.2727	1.1071	1.4588	12.421	5	0.704	1.860	0.0121
MWAT052R1	0.9400	0.9895	1.3370	1.1731	1.4588	9.484	5	-0.109	1.860	0.0088
CONTROL	0.9900	1.0421	1.4361	1.3453	1.4588	3.534	5	-2.370	1.860	0.0038
MWRC209R1	0.9700	1.0211	1.3941	1.2490	1.4588	6.802	5	-1.124	1.860	0.0061

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.98889	1.035	-0.1203	-0.8273
Bartlett's Test indicates equal variances (p = 0.54)	10.8229	26.217		
The control means are not significantly different (p = 0.72)	0.37664	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

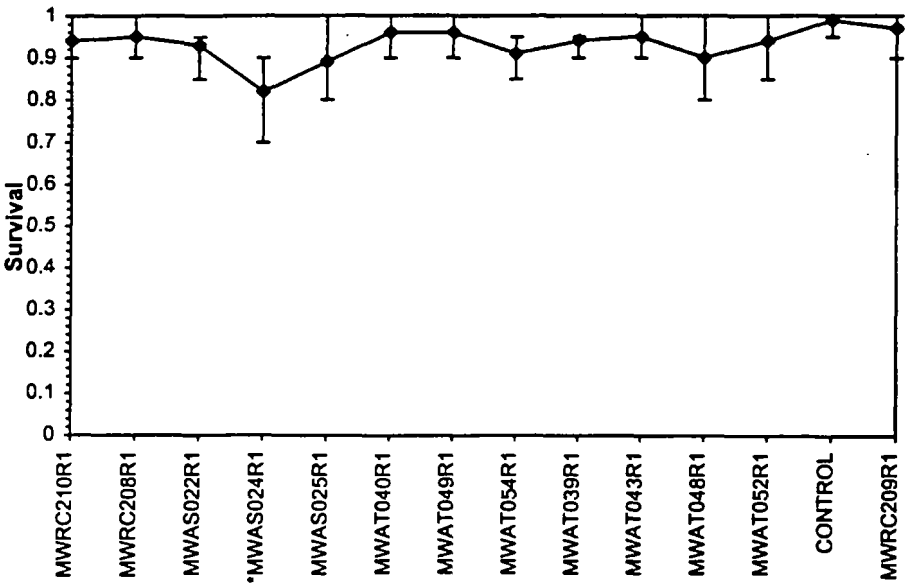
*Significantly different from MWRC210R1.

ToxCalc v5.0.15N

Amphipod Sediment-Survival

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-10-day reburial

Start Date:	5/29/98 13:00	Test ID:	590-1	~~Sample ID:~~	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	1.0000	1.0000	0.9500	1.0000	1.0000
MWRC208R1	1.0000	0.9474	0.9500	1.0000	1.0000
MWAS022R1	0.9474	1.0000	1.0000	1.0000	1.0000
MWAS024R1	1.0000	1.0000	0.8750	1.0000	1.0000
MWAS025R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT040R1	1.0000	0.9474	1.0000	1.0000	0.9500
MWAT049R1	1.0000	0.9444	1.0000	1.0000	1.0000
MWAT054R1	0.9444	1.0000	0.9474	1.0000	1.0000
MWAT039R1	1.0000	0.9444	1.0000	1.0000	0.9474
MWAT043R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT048R1	1.0000	0.9500	1.0000	0.9375	1.0000
MWAT052R1	1.0000	0.9500	1.0000	0.9474	0.9000
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000
MWRC210R1	1.0000	1.0000	0.9500	1.0000	1.0000

Comparisons made to MWRC208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	0.9900	1.0107	1.4343	1.3453	1.4588	3.472	5			
MWRC208R1	0.9795	1.0000	1.4098	1.3393	1.4558	4.374	5			
MWAS022R1	0.9895	1.0102	1.4312	1.3393	1.4558	3.595	5	-0.597	1.860	0.0024
MWAS024R1	0.9750	0.9954	1.3994	1.2094	1.4527	7.603	5	0.189	1.860	0.0056
MWAS025R1	1.0000	1.0210	1.4517	1.4455	1.4588	0.374	5	-1.514	2.132	0.0016
MWAT040R1	0.9795	1.0000	1.4104	1.3393	1.4588	4.411	5	-0.015	1.860	0.0029
MWAT049R1	0.9889	1.0096	1.4324	1.3329	1.4588	3.888	5	-0.607	1.860	0.0026
MWAT054R1	0.9784	0.9989	1.4060	1.3329	1.4558	4.544	5	0.096	1.860	0.0029
MWAT039R1	0.9784	0.9989	1.4079	1.3329	1.4558	4.661	5	0.046	1.860	0.0030
MWAT043R1	1.0000	1.0210	1.4557	1.4527	1.4588	0.209	5	-1.664	2.132	0.0016
MWAT048R1	0.9775	0.9980	1.4041	1.3181	1.4558	4.767	5	0.140	1.860	0.0031
MWAT052R1	0.9595	0.9796	1.3671	1.2490	1.4527	6.255	5	0.905	1.860	0.0041
CONTROL	1.0000	1.0210	1.4582	1.4558	1.4588	0.090	5	-1.754	2.132	0.0016
MWRC210R1	0.9900	1.0107	1.4325	1.3453	1.4558	3.404	5	-0.645	1.860	0.0023

heteroscedastic t-test

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.77395	0.781	-0.931	-1.0682
F-Test indicates equal variances (p = 0.66)	1.59906	23.1539		
The control means are not significantly different (p = 0.51)	0.69042	2.30601		

Hypothesis Test (1-tail, 0.05)

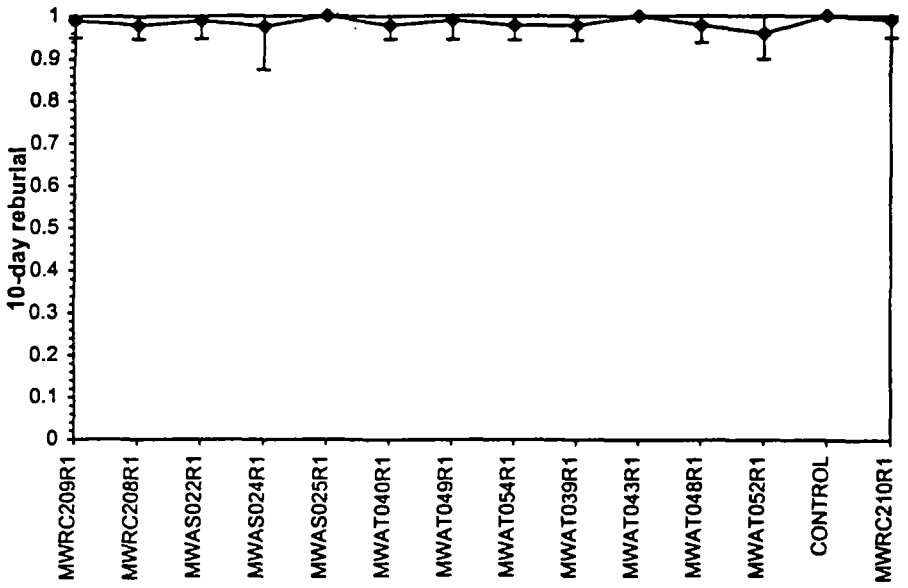
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Amphipod Sediment-10-day reburial

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-10-day reburial

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	1.0000	1.0000	0.9500	1.0000	1.0000
MWRC208R1	1.0000	0.9474	0.9500	1.0000	1.0000
MWAS022R1	0.9474	1.0000	1.0000	1.0000	1.0000
MWAS024R1	1.0000	1.0000	0.8750	1.0000	1.0000
MWAS025R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT040R1	1.0000	0.9474	1.0000	1.0000	0.9500
MWAT049R1	1.0000	0.9444	1.0000	1.0000	1.0000
MWAT054R1	0.9444	1.0000	0.9474	1.0000	1.0000
MWAT039R1	1.0000	0.9444	1.0000	1.0000	0.9474
MWAT043R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT048R1	1.0000	0.9500	1.0000	0.9375	1.0000
MWAT052R1	1.0000	0.9500	1.0000	0.9474	0.9000
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000
MWRC210R1	1.0000	1.0000	0.9500	1.0000	1.0000

Comparisons made to MWRC209R1

			Transform: Arcsin-Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	0.9900	1.0107	1.4343	1.3453	1.4588	3.472	5			
MWRC208R1	0.9795	1.0000	1.4098	1.3393	1.4558	4.374	5			
MWAS022R1	0.9895	1.0102	1.4312	1.3393	1.4558	3.595	5	0.095	1.860	0.0019
MWAS024R1	0.9750	0.9954	1.3994	1.2094	1.4527	7.603	5	0.664	1.860	0.0051
MWAS025R1	1.0000	1.0210	1.4517	1.4455	1.4588	0.374	5	-0.779	2.132	0.0011 ← heteroscedastic t-test
MWAT040R1	0.9795	1.0000	1.4104	1.3393	1.4588	4.411	5	0.670	1.860	0.0024
MWAT049R1	0.9889	1.0096	1.4324	1.3329	1.4588	3.888	5	0.057	1.860	0.0021
MWAT054R1	0.9784	0.9989	1.4060	1.3329	1.4558	4.544	5	0.781	1.860	0.0024
MWAT039R1	0.9784	0.9989	1.4079	1.3329	1.4558	4.661	5	0.714	1.860	0.0025
MWAT043R1	1.0000	1.0210	1.4557	1.4527	1.4588	0.209	5	-0.962	2.132	0.0011
MWAT048R1	0.9775	0.9980	1.4041	1.3181	1.4558	4.767	5	0.808	1.860	0.0026
MWAT052R1	0.9595	0.9796	1.3671	1.2490	1.4527	6.255	5	1.517	1.860	0.0036
CONTROL	1.0000	1.0210	1.4582	1.4558	1.4588	0.090	5	-1.073	2.132	0.0011
MWRC210R1	0.9900	1.0107	1.4325	1.3453	1.4558	3.404	5	0.058	1.860	0.0018

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.55002	0.781	-1.771	1.3925
F-Test indicates equal variances (p = 0.97)	1.04334	23.1539		
The control means are not significantly different (p = 0.51)	0.69042	2.30601		

Hypothesis Test (1-tail, 0.05)

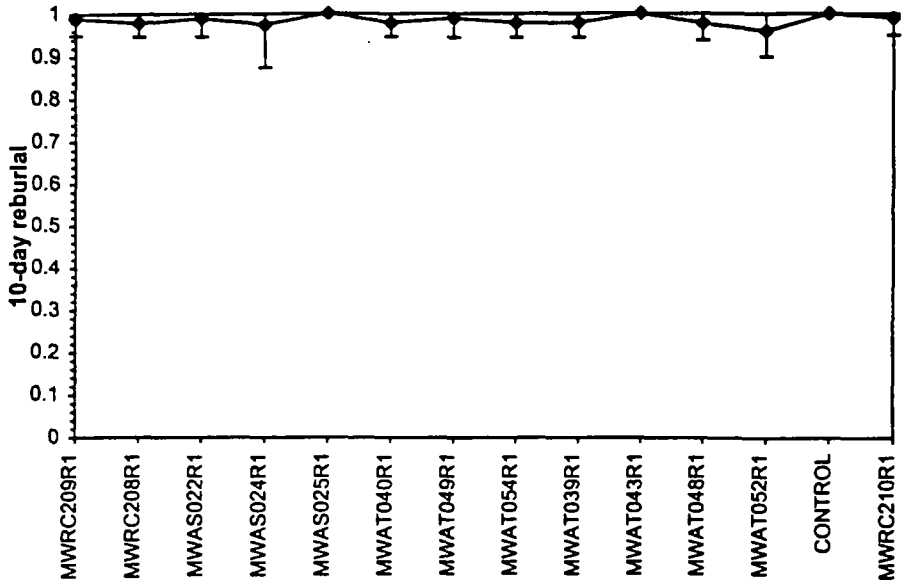
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Amphipod Sediment-10-day reburial

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-10-day reburial

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC210R1	1.0000	1.0000	0.9500	1.0000	1.0000
MWRC208R1	1.0000	0.9474	0.9500	1.0000	1.0000
MWAS022R1	0.9474	1.0000	1.0000	1.0000	1.0000
MWAS024R1	1.0000	1.0000	0.8750	1.0000	1.0000
MWAS025R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT040R1	1.0000	0.9474	1.0000	1.0000	0.9500
MWAT049R1	1.0000	0.9444	1.0000	1.0000	1.0000
MWAT054R1	0.9444	1.0000	0.9474	1.0000	1.0000
MWAT039R1	1.0000	0.9444	1.0000	1.0000	0.9474
MWAT043R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT048R1	1.0000	0.9500	1.0000	0.9375	1.0000
MWAT052R1	1.0000	0.9500	1.0000	0.9474	0.9000
CONTROL	1.0000	1.0000	1.0000	1.0000	1.0000
MWRC209R1	1.0000	1.0000	0.9500	1.0000	1.0000

Comparison to MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC210R1	0.9900	1.0107	1.4325	1.3453	1.4558	3.404	5			
MWRC208R1	0.9795	1.0000	1.4098	1.3393	1.4558	4.374	5			
MWAS022R1	0.9895	1.0102	1.4312	1.3393	1.4558	3.595	5	0.039	1.860	0.0019
MWAS024R1	0.9750	0.9954	1.3994	1.2094	1.4527	7.603	5	0.632	1.860	0.0051
MWAS025R1	1.0000	1.0210	1.4517	1.4455	1.4588	0.374	5	-0.877	2.132	0.0010
MWAT040R1	0.9795	1.0000	1.4104	1.3393	1.4588	4.411	5	0.625	1.860	0.0023
MWAT049R1	0.9889	1.0096	1.4324	1.3329	1.4588	3.888	5	0.003	1.860	0.0020
MWAT054R1	0.9784	0.9989	1.4060	1.3329	1.4558	4.544	5	0.737	1.860	0.0024
MWAT039R1	0.9784	0.9989	1.4079	1.3329	1.4558	4.661	5	0.671	1.860	0.0025
MWAT043R1	1.0000	1.0210	1.4557	1.4527	1.4588	0.209	5	-1.066	2.132	0.0010
MWAT048R1	0.9775	0.9980	1.4041	1.3181	1.4558	4.767	5	0.766	1.860	0.0026
MWAT052R1	0.9595	0.9796	1.3671	1.2490	1.4527	6.255	5	1.484	1.860	0.0036
CONTROL	1.0000	1.0210	1.4582	1.4558	1.4588	0.090	5	-1.179	2.132	0.0010
MWRC209R1	0.9900	1.0107	1.4343	1.3453	1.4588	3.472	5	-0.058	1.860	0.0018

heteroscedastic t-test

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.55002	0.781	-1.771	1.3925
F-Test indicates equal variances (p = 0.97)	1.04334	23.1539		
The control means are not significantly different (p = 0.54)	0.64489	2.30601		

Hypothesis Test (1-tail, 0.05)

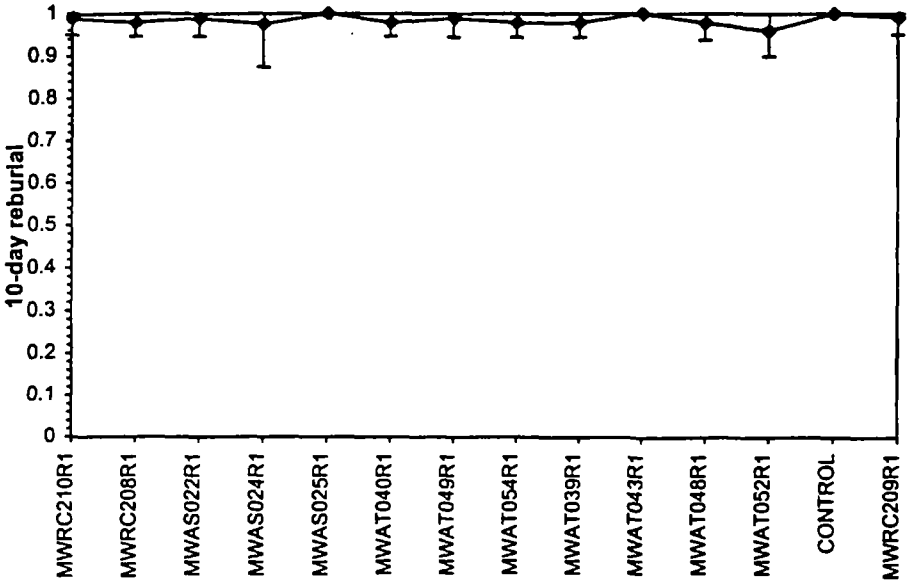
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Amphipod Sediment-10-day reburial

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-Total Effective Mortality

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	0.0000	0.0000	0.0500	0.0500	0.1000
MWRC208R1	0.1000	0.1000	0.0500	0.0500	0.0500
MWAS022R1	0.1000	0.1500	0.0500	0.0500	0.0500
MWAS024R1	0.1000	0.1000	0.3000	0.3000	0.2000
MWAS025R1	0.2000	0.0000	0.1500	0.0500	0.1500
MWAT040R1	0.1000	0.1000	0.0500	0.0000	0.0500
MWAT049R1	0.0000	0.1500	0.0000	0.0000	0.1000
MWAT054R1	0.1500	0.1500	0.1000	0.0500	0.1000
MWAT039R1	0.0500	0.1500	0.0500	0.0500	0.1000
MWAT043R1	0.0500	0.1000	0.0000	0.1000	0.0000
MWAT048R1	0.2000	0.0500	0.0500	0.2500	0.0500
MWAT052R1	0.1000	0.0500	0.1500	0.1000	0.1000
CONTROL	0.0500	0.0000	0.0000	0.0000	0.0000
MWRC210R1	0.0500	0.1000	0.0500	0.0500	0.1000

Comparisons made to MWRC208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	0.0400	0.5714	0.1994	0.1120	0.3218	44.580	5			
MWRC208R1	0.0700	1.0000	0.2640	0.2255	0.3218	19.966	5			
MWAS022R1	0.0800	1.1429	0.2792	0.2255	0.3977	28.031	5	0.360	1.860	0.0033
* MWAS024R1	0.2000	2.8571	0.4533	0.3218	0.5796	28.475	5	3.036	1.860	0.0072
MWAS025R1	0.1100	1.5714	0.3193	0.1120	0.4636	45.620	5	0.798	1.860	0.0089
MWAT040R1	0.0600	0.8571	0.2413	0.1120	0.3218	35.979	5	-0.500	1.860	0.0038
MWAT049R1	0.0500	0.7143	0.2111	0.1120	0.3977	65.508	5	-0.799	1.860	0.0081
MWAT054R1	0.1100	1.5714	0.3329	0.2255	0.3977	21.336	5	1.741	1.860	0.0029
MWAT039R1	0.0800	1.1429	0.2792	0.2255	0.3977	28.031	5	0.360	1.860	0.0033
MWAT043R1	0.0500	0.7143	0.2186	0.1120	0.3218	47.996	5	-0.864	1.860	0.0051
MWAT048R1	0.1200	1.7143	0.3328	0.2255	0.5236	44.589	5	0.976	1.860	0.0092
MWAT052R1	0.1000	1.4286	0.3177	0.2255	0.3977	19.242	5	1.487	1.860	0.0024
CONTROL	0.0100	0.1429	0.1347	0.1120	0.2255	37.666	5	-3.951	1.860	0.0020
MWRC210R1	0.0700	1.0000	0.2640	0.2255	0.3218	19.966	5	0.000	1.860	0.0021

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.77998	1.035	0.12599	-0.7073
Bartlett's Test indicates equal variances (p = 0.32)	13.6623	26.217		
The control means are not significantly different (p = 0.20)	1.39871	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

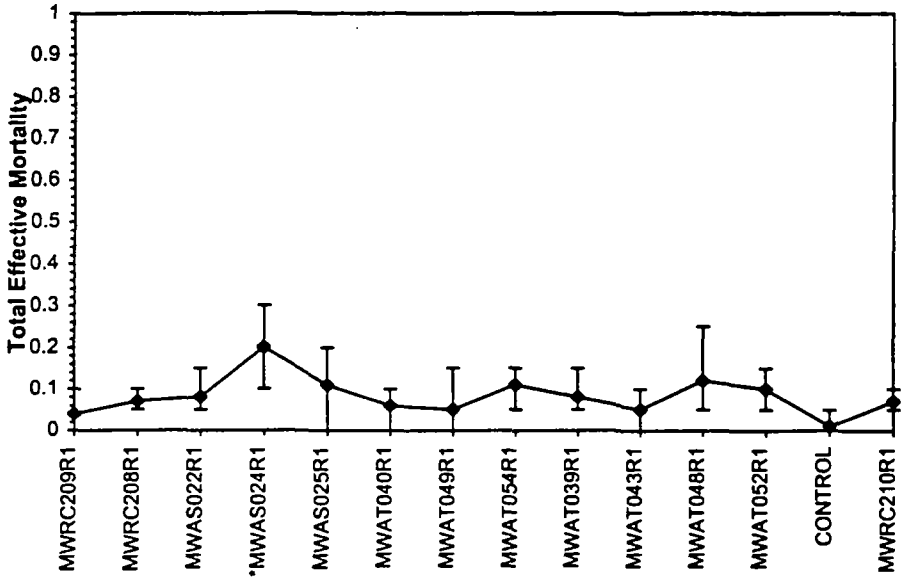
*significantly different from MWRC208R1.

ToxCalc v5.0.15N

Amphipod Sediment-Total Effective Mortality

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment Total Effective Mortality

Start Date:	5/29/98 13:00	Test ID:	590-1	~~Sample ID:~~	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	0.0000	0.0000	0.0500	0.0500	0.1000
MWRC208R1	0.1000	0.1000	0.0500	0.0500	0.0500
MWAS022R1	0.1000	0.1500	0.0500	0.0500	0.0500
MWAS024R1	0.1000	0.1000	0.3000	0.3000	0.2000
MWAS025R1	0.2000	0.0000	0.1500	0.0500	0.1500
MWAT040R1	0.1000	0.1000	0.0500	0.0000	0.0500
MWAT049R1	0.0000	0.1500	0.0000	0.0000	0.1000
MWAT054R1	0.1500	0.1500	0.1000	0.0500	0.1000
MWAT039R1	0.0500	0.1500	0.0500	0.0500	0.1000
MWAT043R1	0.0500	0.1000	0.0000	0.1000	0.0000
MWAT048R1	0.2000	0.0500	0.0500	0.2500	0.0500
MWAT052R1	0.1000	0.0500	0.1500	0.1000	0.1000
CONTROL	0.0500	0.0000	0.0000	0.0000	0.0000
MWRC210R1	0.0500	0.1000	0.0500	0.0500	0.1000

Comparisons made to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	0.0400	0.5714	0.1994	0.1120	0.3218	44.580	5			
MWRC208R1	0.0700	1.0000	0.2640	0.2255	0.3218	19.966	5			
MWAS022R1	0.0800	1.1429	0.2792	0.2255	0.3977	28.031	5	1.507	1.860	0.0052
*MWAS024R1	0.2000	2.8571	0.4533	0.3218	0.5796	28.475	5	3.623	1.860	0.0091
MWAS025R1	0.1100	1.5714	0.3193	0.1120	0.4636	45.620	5	1.572	1.860	0.0108
MWAT040R1	0.0600	0.8571	0.2413	0.1120	0.3218	35.979	5	0.755	1.860	0.0057
MWAT049R1	0.0500	0.7143	0.2111	0.1120	0.3977	65.508	5	0.160	1.860	0.0101
*MWAT054R1	0.1100	1.5714	0.3329	0.2255	0.3977	21.336	5	2.624	1.860	0.0048
MWAT039R1	0.0800	1.1429	0.2792	0.2255	0.3977	28.031	5	1.507	1.860	0.0052
MWAT043R1	0.0500	0.7143	0.2186	0.1120	0.3218	47.996	5	0.313	1.860	0.0070
MWAT048R1	0.1200	1.7143	0.3328	0.2255	0.5236	44.589	5	1.725	1.860	0.0111
*MWAT052R1	0.1000	1.4286	0.3177	0.2255	0.3977	19.242	5	2.453	1.860	0.0043
CONTROL	0.0100	0.1429	0.1347	0.1120	0.2255	37.666	5	-1.412	1.860	0.0039
MWRC210R1	0.0700	1.0000	0.2640	0.2255	0.3218	19.966	5	1.399	1.860	0.0040

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.76294	1.035	0.12567	-0.814
Bartlett's Test indicates equal variances (p = 0.47)	11.7172	26.217		
The control means are not significantly different (p = 0.20)	1.39871	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

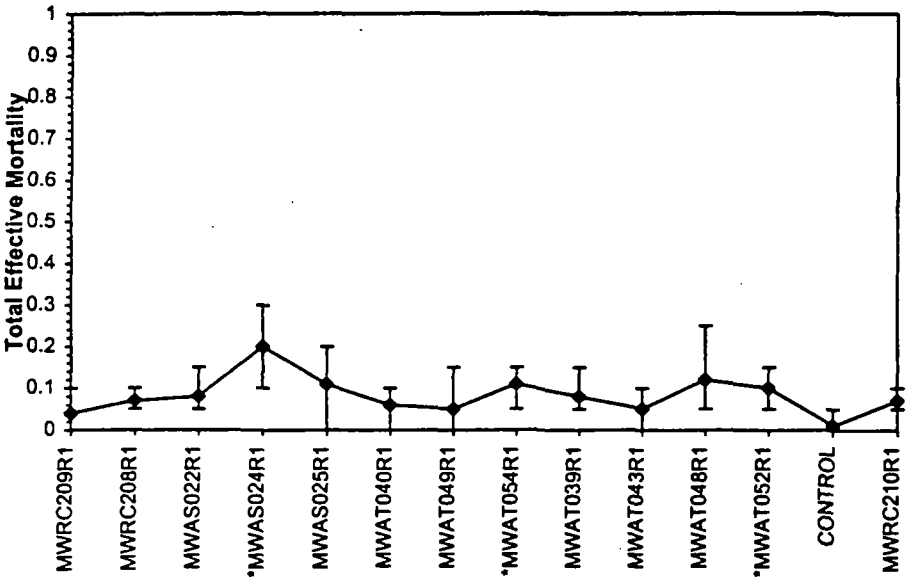
*significantly different from MWRC209R1

ToxCalc v5.0.15N

Amphipod Sediment-Total Effective Mortality

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-Total Effective Mortality

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC210R1	0.0500	0.1000	0.0500	0.0500	0.1000
MWRC208R1	0.1000	0.1000	0.0500	0.0500	0.0500
MWAS022R1	0.1000	0.1500	0.0500	0.0500	0.0500
MWAS024R1	0.1000	0.1000	0.3000	0.3000	0.2000
MWAS025R1	0.2000	0.0000	0.1500	0.0500	0.1500
MWAT040R1	0.1000	0.1000	0.0500	0.0000	0.0500
MWAT049R1	0.0000	0.1500	0.0000	0.0000	0.1000
MWAT054R1	0.1500	0.1500	0.1000	0.0500	0.1000
MWAT039R1	0.0500	0.1500	0.0500	0.0500	0.1000
MWAT043R1	0.0500	0.1000	0.0000	0.1000	0.0000
MWAT048R1	0.2000	0.0500	0.0500	0.2500	0.0500
MWAT052R1	0.1000	0.0500	0.1500	0.1000	0.1000
CONTROL	0.0500	0.0000	0.0000	0.0000	0.0000
MWRC209R1	0.0000	0.0000	0.0500	0.0500	0.1000

Comparison to MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC210R1	0.0700	1.0000	0.2640	0.2255	0.3218	19.966	5			
MWRC208R1	0.0700	1.0000	0.2640	0.2255	0.3218	19.966	5			
MWAS022R1	0.0800	1.1429	0.2792	0.2255	0.3977	28.031	5	0.360	1.860	0.0033
*MWAS024R1	0.2000	2.8571	0.4533	0.3218	0.5796	28.475	5	3.036	1.860	0.0072
MWAS025R1	0.1100	1.5714	0.3193	0.1120	0.4636	45.620	5	0.798	1.860	0.0089
MWAT040R1	0.0600	0.8571	0.2413	0.1120	0.3218	35.979	5	-0.500	1.860	0.0038
MWAT049R1	0.0500	0.7143	0.2111	0.1120	0.3977	65.508	5	-0.799	1.860	0.0081
MWAT054R1	0.1100	1.5714	0.3329	0.2255	0.3977	21.336	5	1.741	1.860	0.0029
MWAT039R1	0.0800	1.1429	0.2792	0.2255	0.3977	28.031	5	0.360	1.860	0.0033
MWAT043R1	0.0500	0.7143	0.2186	0.1120	0.3218	47.996	5	-0.864	1.860	0.0051
MWAT048R1	0.1200	1.7143	0.3328	0.2255	0.5236	44.589	5	0.976	1.860	0.0092
MWAT052R1	0.1000	1.4286	0.3177	0.2255	0.3977	19.242	5	1.487	1.860	0.0024
CONTROL	0.0100	0.1429	0.1347	0.1120	0.2255	37.666	5	-3.951	1.860	0.0020
MWRC209R1	0.0400	0.5714	0.1994	0.1120	0.3218	44.580	5	-1.399	1.860	0.0040

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.76294	1.035	0.12567	-0.814
Bartlett's Test indicates equal variances (p = 0.47)	11.7172	26.217		
The control means are not significantly different (p = 1.00)	0	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

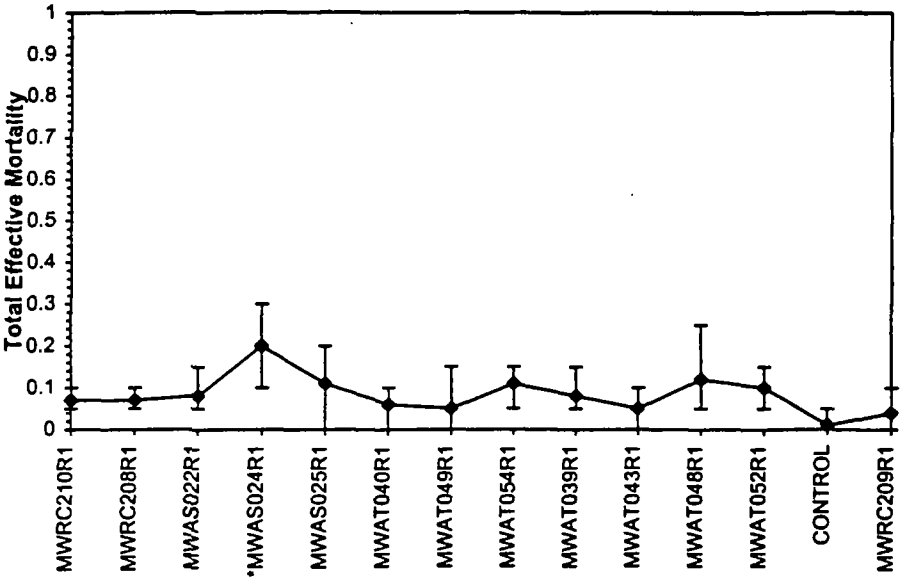
*significantly different from MWRC210R1

ToxCalc v5.0.15N

Amphipod Sediment-Total Effective Mortality

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-Total emergence

Start Date:	5/29/98 13:00	Test ID:	590-1	~~Sample ID:~~	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	2.0000	3.0000	0.0000	3.0000	1.0000
MWRC208R1	7.0000	6.0000	0.0000	0.0000	2.0000
MWAS022R1	8.0000	4.0000	3.0000	2.0000	1.0000
MWAS024R1	3.0000	12.0000	13.0000	4.0000	4.0000
MWAS025R1	4.0000	0.0000	11.0000	9.0000	4.0000
MWAT040R1	3.0000	2.0000	5.0000	1.0000	3.0000
MWAT049R1	4.0000	1.0000	0.0000	0.0000	1.0000
MWAT054R1	3.0000	3.0000	4.0000	2.0000	6.0000
MWAT039R1	3.0000	3.0000	6.0000	3.0000	3.0000
MWAT043R1	0.0000	2.0000	4.0000	2.0000	0.0000
MWAT048R1	3.0000	0.0000	0.0000	0.0000	14.0000
MWAT052R1	4.0000	2.0000	6.0000	4.0000	6.0000
CONTROL	11.0000	8.0000	0.0000	9.0000	4.0000
MWRC210R1	1.0000	13.0000	1.0000	4.0000	1.0000

Comparisons made to MWRC208R1

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	1.8000	0.6000	1.8000	0.0000	3.0000	72.436	5			
MWRC208R1	3.0000	1.0000	3.0000	0.0000	7.0000	110.554	5			
MWAS022R1	3.6000	1.2000	3.6000	1.0000	8.0000	75.051	5	0.314	1.860	6.8059
MWAS024R1	7.2000	2.4000	7.2000	3.0000	13.0000	67.615	5	1.594	1.860	12.9053
MWAS025R1	5.6000	1.8667	5.6000	0.0000	11.0000	78.450	5	1.056	1.860	11.2689
MWAT040R1	2.8000	0.9333	2.8000	1.0000	5.0000	52.973	5	-0.123	1.860	4.9092
MWAT049R1	1.2000	0.4000	1.2000	0.0000	4.0000	136.931	5	-1.087	1.860	5.0952
MWAT054R1	3.6000	1.2000	3.6000	2.0000	6.0000	42.127	5	0.368	1.860	4.9464
MWAT039R1	3.6000	1.2000	3.6000	3.0000	6.0000	37.268	5	0.375	1.860	4.7604
MWAT043R1	1.6000	0.5333	1.6000	0.0000	4.0000	104.583	5	-0.843	1.860	5.1324
MWAT048R1	3.4000	1.1333	3.4000	0.0000	14.0000	178.421	5	0.129	1.860	17.7773
MWAT052R1	4.4000	1.4667	4.4000	2.0000	6.0000	38.030	5	0.843	1.860	5.1324
CONTROL	6.4000	2.1333	6.4000	0.0000	11.0000	68.643	5	1.381	1.860	11.2689
MWRC210R1	4.0000	1.3333	4.0000	1.0000	13.0000	129.904	5	0.363	1.860	14.1326

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.28244	1.035	0.97138	1.6152
Bartlett's Test indicates equal variances (p = 0.01)	25.3894	26.217		
The control means are not significantly different (p = 0.47)	0.75295	2.30601		

Hypothesis Test (1-tail, 0.05)

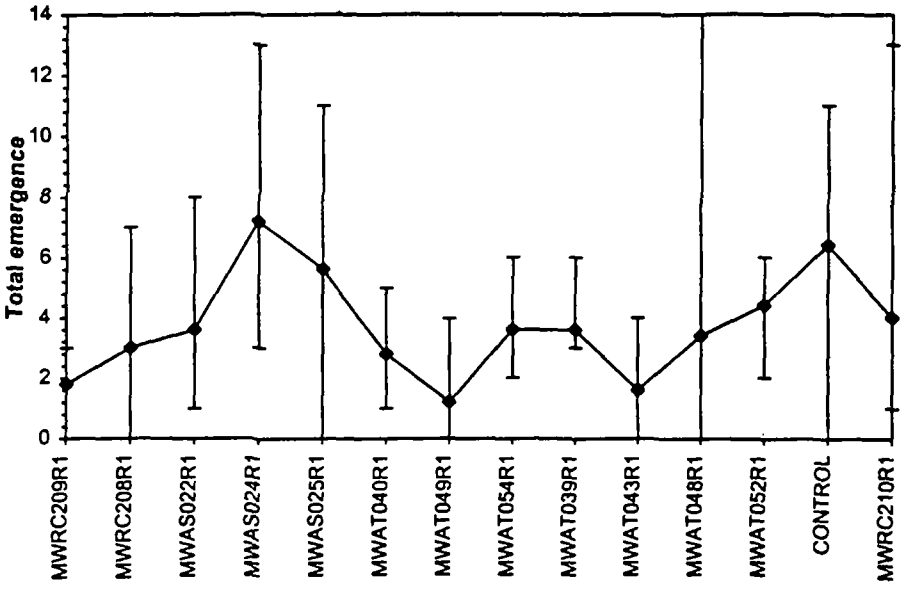
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Amphipod Sediment-Total emergence

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



Amphipod Sediment Total emergence

Start Date:	5/29/98 13:00	Test ID:	590-1	~~Sample ID:~~	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC209R1	2.0000	3.0000	0.0000	3.0000	1.0000
MWRC208R1	7.0000	6.0000	0.0000	0.0000	2.0000
MWAS022R1	8.0000	4.0000	3.0000	2.0000	1.0000
MWAS024R1	3.0000	12.0000	13.0000	4.0000	4.0000
MWAS025R1	4.0000	0.0000	11.0000	9.0000	4.0000
MWAT040R1	3.0000	2.0000	5.0000	1.0000	3.0000
MWAT049R1	4.0000	1.0000	0.0000	0.0000	1.0000
MWAT054R1	3.0000	3.0000	4.0000	2.0000	6.0000
MWAT039R1	3.0000	3.0000	6.0000	3.0000	3.0000
MWAT043R1	0.0000	2.0000	4.0000	2.0000	0.0000
MWAT048R1	3.0000	0.0000	0.0000	0.0000	14.0000
MWAT052R1	4.0000	2.0000	6.0000	4.0000	6.0000
CONTROL	11.0000	8.0000	0.0000	9.0000	4.0000
MWRC210R1	1.0000	13.0000	1.0000	4.0000	1.0000

Comparisons made to MWRC 209R1

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC209R1	1.8000	0.6000	1.8000	0.0000	3.0000	72.436	5			
MWRC208R1	3.0000	1.0000	3.0000	0.0000	7.0000	110.554	5			
MWAS022R1	3.6000	1.2000	3.6000	1.0000	8.0000	75.051	5	1.342	1.860	3.3472
* MWAS024R1	7.2000	2.4000	7.2000	3.0000	13.0000	67.615	5	2.396	1.860	9.4465
MWAS025R1	5.6000	1.8667	5.6000	0.0000	11.0000	78.450	5	1.854	1.860	7.8101
MWAT040R1	2.8000	0.9333	2.8000	1.0000	5.0000	52.973	5	1.132	1.860	1.4504
MWAT049R1	1.2000	0.4000	1.2000	0.0000	4.0000	136.931	5	-0.640	1.860	1.6364
* MWAT054R1	3.6000	1.2000	3.6000	2.0000	6.0000	42.127	5	2.012	1.860	1.4876
* MWAT039R1	3.6000	1.2000	3.6000	3.0000	6.0000	37.268	5	2.151	1.860	1.3017
MWAT043R1	1.6000	0.5333	1.6000	0.0000	4.0000	104.583	5	-0.211	1.860	1.6736
MWAT048R1	3.4000	1.1333	3.4000	0.0000	14.0000	178.421	5	0.577	1.860	14.3185
* MWAT052R1	4.4000	1.4667	4.4000	2.0000	6.0000	38.030	5	2.741	1.860	1.6736
*CONTROL	6.4000	2.1333	6.4000	0.0000	11.0000	68.643	5	2.245	1.860	7.8101
MWRC210R1	4.0000	1.3333	4.0000	1.0000	13.0000	129.904	5	0.918	1.860	10.6738

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.01)	1.26991	1.035	1.04138	2.13007
Bartlett's Test indicates unequal variances (p = 3.47E-03)	29.3674	26.217		
The control means are not significantly different (p = 0.47)	0.75295	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates significant differences

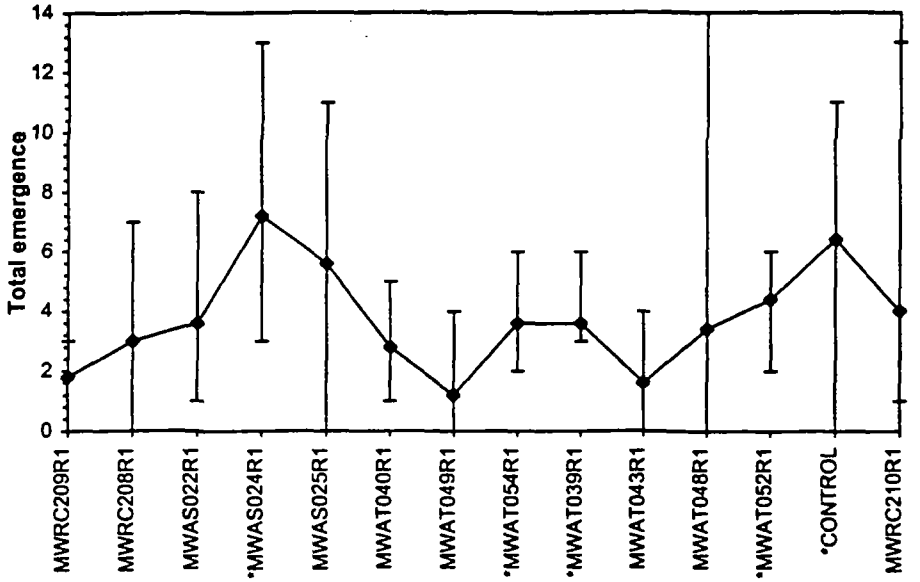
* significantly different from MWRC 209R1

ToxCalc v5.0.15N

Amphipod Sediment-Total emergence

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Amphipod Sediment-Total emergence

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-	1	2	3	4	5
MWRC210R1	1.0000	13.0000	1.0000	4.0000	1.0000
MWRC208R1	7.0000	6.0000	0.0000	0.0000	2.0000
MWAS022R1	8.0000	4.0000	3.0000	2.0000	1.0000
MWAS024R1	3.0000	12.0000	13.0000	4.0000	4.0000
MWAS025R1	4.0000	0.0000	11.0000	9.0000	4.0000
MWAT040R1	3.0000	2.0000	5.0000	1.0000	3.0000
MWAT049R1	4.0000	1.0000	0.0000	0.0000	1.0000
MWAT054R1	3.0000	3.0000	4.0000	2.0000	6.0000
MWAT039R1	3.0000	3.0000	6.0000	3.0000	3.0000
MWAT043R1	0.0000	2.0000	4.0000	2.0000	0.0000
MWAT048R1	3.0000	0.0000	0.0000	0.0000	14.0000
MWAT052R1	4.0000	2.0000	6.0000	4.0000	6.0000
CONTROL	11.0000	8.0000	0.0000	9.0000	4.0000
MWRC209R1	2.0000	3.0000	0.0000	3.0000	1.0000

Comparison to MWRC210R1

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC210R1	4.0000	1.3333	4.0000	1.0000	13.0000	129.904	5			
MWRC208R1	3.0000	1.0000	3.0000	0.0000	7.0000	110.554	5			
MWAS022R1	3.6000	1.2000	3.6000	1.0000	8.0000	75.051	5	-0.153	1.860	12.7565
MWAS024R1	7.2000	2.4000	7.2000	3.0000	13.0000	67.615	5	1.005	1.860	18.8558
MWAS025R1	5.6000	1.8667	5.6000	0.0000	11.0000	78.450	5	0.526	1.860	17.2194
MWAT040R1	2.8000	0.9333	2.8000	1.0000	5.0000	52.973	5	-0.497	1.860	10.8598
MWAT049R1	1.2000	0.4000	1.2000	0.0000	4.0000	136.931	5	-1.149	1.860	11.0457
MWAT054R1	3.6000	1.2000	3.6000	2.0000	6.0000	42.127	5	-0.165	1.860	10.8970
MWAT039R1	3.6000	1.2000	3.6000	3.0000	6.0000	37.268	5	-0.167	1.860	10.7110
MWAT043R1	1.6000	0.5333	1.6000	0.0000	4.0000	104.583	5	-0.983	1.860	11.0829
MWAT048R1	3.4000	1.1333	3.4000	0.0000	14.0000	178.421	5	-0.168	1.860	23.7278
MWAT052R1	4.4000	1.4667	4.4000	2.0000	6.0000	38.030	5	0.164	1.860	11.0829
CONTROL	6.4000	2.1333	6.4000	0.0000	11.0000	68.643	5	0.789	1.860	17.2194
MWRC209R1	1.8000	0.6000	1.8000	0.0000	3.0000	72.436	5	-0.918	1.860	10.6738

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.77707	0.781	1.96679	4.8079
F-Test indicates equal variances (p = 0.02)	15.8824	23.1539		
The control means are not significantly different (p = 0.73)	0.36274	2.30601		

Hypothesis Test (1-tail, 0.05)

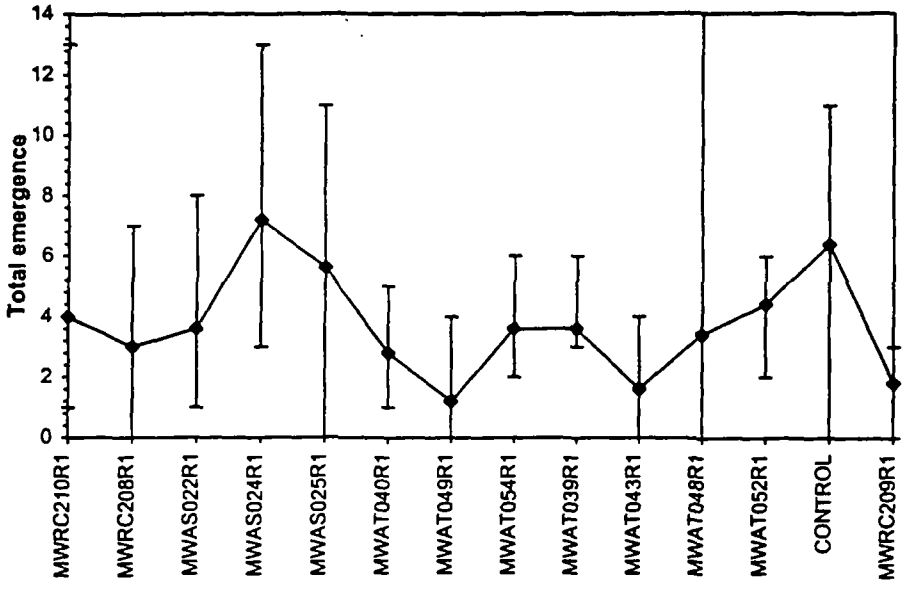
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Amphipod Sediment-Total emergence

Start Date:	5/29/98 13:00	Test ID:	590-1	Sample ID:	
End Date:	6/8/98 13:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	RA-Rhepoxynius abronius
Comments:					

Dose-Response Plot



TOXCHK DATA ENTRY SHEET, for comparison to MWRC208R1 and MWRC209R1; data was transferred from EXCEL spreadsheet. An "*" indicates values in column were verified again in EXCEL spreadsheet - DLR 7-14-98

Test: AS-Amphipod Sediment
Species: RA-Rhepoxynius abronius
Sample ID:
Start Date: 5/29/98 13:00 End Date: 6/8/98 13 00

Test ID 590-1
Protocol: PSEP 1995-Puget Sound
Sample Type: SED-Sediment
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Day 0	Day 10*	Proportion Survived	Number Reburied*	Prop Survivors buried	Prop TEM	No.emerged day1	No.emerged day2	No.emerged day3	No.emerged day4	No.emerged day5	No.emerged day6	No.emerged day7	No.emerged day8	No.emerged day9	No.emerged day10	Total emerged*
	1	1	MWRC209R1	20	20	1	20	1	0	0	0	2	0	0	0	0	0	0	0	2
	2	2	MWRC209R1	20	20	1	20	1	0	0	0	1	1	0	0	0	0	1	0	3
	3	3	MWRC209R1	20	20	1	19	0 95	0 05	0	0	0	0	0	0	0	0	0	0	0
	4	4	MWRC209R1	20	19	0 95	19	1	0 05	0	0	0	1	0	0	0	0	0	2	3
	5	5	MWRC209R1	20	18	0 9	18	1	0 1	0	0	0	1	0	0	0	0	0	0	1
	6	1	MWRC208R1	20	18	0 9	18	1	0 1	0	0	2	2	0	0	0	2	0	1	7
	7	2	MWRC208R1	20	19	0 95	18	0 94736842	0 1	0	0	1	1	0	0	2	0	1	1	6
	8	3	MWRC208R1	20	20	1	19	0 95	0 05	0	0	0	0	0	0	0	0	0	0	0
	9	4	MWRC208R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	0	0	0	0
	10	5	MWRC208R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	1	0	1	2
	11	1	MWAS022R1	20	19	0 95	18	0 94736842	0 1	2	1	0	2	0	0	1	0	0	2	8
	12	2	MWAS022R1	20	17	0 85	17	1	0 15	0	0	0	0	0	0	1	2	0	1	4
	13	3	MWAS022R1	20	19	0 95	19	1	0 05	0	0	1	0	0	0	0	0	0	2	3
	14	4	MWAS022R1	20	19	0 95	19	1	0 05	1	0	0	0	0	0	0	1	0	0	2
	15	5	MWAS022R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	0	0	1	1
	16	1	MWAS024R1	20	18	0 9	18	1	0 1	0	0	0	0	0	0	0	1	0	2	3
	17	2	MWAS024R1	20	18	0 9	18	1	0 1	0	0		1	1	1	2	3	2	2	12
	18	3	MWAS024R1	20	16	0 8	14	0 875	0 3	0	0	1	2	0	0	5	0	4	1	13
	19	4	MWAS024R1	20	14	0 7	14	1	0 3	0	0	0	0	0	0	0	0	2	2	4
	20	5	MWAS024R1	20	16	0 8	16	1	0 2	0	0	0	0	0	0	2	2	0	0	4
	21	1	MWAS025R1	20	16	0 8	16	1	0 2	0	0	0	1	0	0	2	0	0	1	4
	22	2	MWAS025R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	23	3	MWAS025R1	20	17	0 85	17	1	0 15	0	1	0	0	1	4	4	1	0	0	11
	24	4	MWAS025R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	2	2	2	3	9
	25	5	MWAS025R1	20	17	0 85	17	1	0 15	0	1	1	0	0	0	0	1	1	0	4
	26	1	MWAT040R1	20	18	0 9	18	1	0 1	0	0	1	0	0	0	0	0	0	2	3
	27	2	MWAT040R1	20	19	0 95	18	0 94736842	0.1	0	0	0	1	0	0	0	0	1	0	2
	28	3	MWAT040R1	20	19	0 95	19	1	0 05	0	0	0	1	0	0	1	1	1	1	5
	29	4	MWAT040R1	20	20	1	20	1	0	0	0	0	0	0	0	0	1	0	0	1
	30	5	MWAT040R1	20	20	1	19	0 95	0.05	0	0	0	0	0	0	0	0	2	1	3
	31	1	MWAT049R1	20	20	1	20	1	0	0	0	0	0	1	0	1	0	0	2	4
	32	2	MWAT049R1	20	18	0 9	17	0 94444444	0 15	1	0	0	0	0	0	0	0	0	0	1
	33	3	MWAT049R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	34	4	MWAT049R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	35	5	MWAT049R1	20	18	0 9	18	1	0 1	0	0	0	0	0	0	0	0	0	1	1
	36	1	MWAT054R1	20	18	0 9	17	0 94444444	0 15	1	0	0	0	0	0	0	0	1	1	3
	37	2	MWAT054R1	20	17	0 85	17	1	0 15	0	0	0	0	0	0	0	3	0	0	3
	38	3	MWAT054R1	20	19	0 95	18	0 94736842	0 1	0	0	0	0	0	0	0	1	2	1	4
	39	4	MWAT054R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	0	1	1	2
	40	5	MWAT054R1	20	18	0 9	18	1	0 1	0	1	1	0	1	0	1	1	0	1	6
	41	1	MWAT039R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	1	0	1	1	3
	42	2	MWAT039R1	20	18	0 9	17	0 94444444	0 15	0	0	0	0	0	0	0	0	2	1	3
	43	3	MWAT039R1	20	19	0 95	19	1	0 05	0	1	0	0	1	2	0	0	0	2	6
	44	4	MWAT039R1	20	19	0 95	19	1	0 05	0	0	1	0	0	1	0	0	0	1	3
	45	5	MWAT039R1	20	19	0 95	18	0 94736842	0 1	1	0	0	1	0	0	0	1	0	0	3
	46	1	MWAT043R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	0	0	0	0

Test: AS-Amphipod Sediment
Species: RA-Rhepoxynius *abronius*
Sample ID:
Start Date: 5/29/98 13.00 End Date: 6/8/98 13 00

Test ID. 590-1
Protocol PSEP 1995-Puget Sound
Sample Type: SED-Sediment
Lab ID: ORNAS-Northwestern Aquatic Sciences

	47	2	MWAT043R1	20	18	0 9	18	1	0.1	1	0	0	0	0	0	1	0	0	0	2
	48	3	MWAT043R1	20	20	1	20	1	0	0	0	0	0	0	0	1	0	0	3	4
	49	4	MWAT043R1	20	18	0 9	18	1	0 1	0	0	0	2	0	0	0	0	0	0	2
	50	5	MWAT043R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	51	1	MWAT048R1	20	16	0 8	16	1	0 2	0	0	0	0	0	0	0	1	0	2	3
	52	2	MWAT048R1	20	20	1	19	0 95	0 05	0	0	0	0	0	0	0	0	0	0	0
	53	3	MWAT048R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	0	0	0	0
	54	4	MWAT048R1	20	16	0 8	15	0 9375	0 25	0	0	0	0	0	0	0	0	0	0	0
	55	5	MWAT048R1	20	19	0 95	19	1	0 05	0	0	1	0	0	2	4	2	2	3	14
	56	1	MWAT052R1	20	18	0 9	18	1	0 1	0	0	1	1	0	0	1	0	0	1	4
	57	2	MWAT052R1	20	20	1	19	0 95	0 05	0	0	0	0	0	0	0	0	0	2	2
	58	3	MWAT052R1	20	17	0 85	17	1	0 15	1	1	0	0	0	0	0	0	0	4	6
	59	4	MWAT052R1	20	19	0 95	18	0 94736842	0 1	0	0	0	0	0	0	0	0	2	2	4
	60	5	MWAT052R1	20	20	1	18	0 9	0 1	0	2	1	0	1	0	0	0	0	2	6
	61	1	CONTROL	20	19	0 95	19	1	0 05	1	0	0	2	0	0	2	2	2	2	11
	62	2	CONTROL	20	20	1	20	1	0	0	0	0	1	1	2	1	1	1	1	8
	63	3	CONTROL	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	64	4	CONTROL	20	20	1	20	1	0	0	0	0	1	1	0	2	2	1	2	9
	65	5	CONTROL	20	20	1	20	1	0	0	0	0	1	0	0	1	0	1	1	4
	66	1	MWRC210R1	20	19	0 95	19	1	0 05	0	0	0	0	1	0	0	0	0	0	1
	67	2	MWRC210R1	20	18	0 9	18	1	0 1	0	0	1	1	0	1	2	3	2	3	13
	68	3	MWRC210R1	20	20	1	19	0 95	0.05	0	0	0	0	0	0	0	1	0	0	1
	69	4	MWRC210R1	20	19	0 95	19	1	0 05	0	0	0	1	1	0	0	1	1	0	4
	70	5	MWRC210R1	20	18	0 9	18	1	0.1	0	0	0	0	0	0	0	0	0	1	1

Comments:

TOXCALC DATA ENTRY SHEET, for comparisons to MWRC210R1, data was transferred from EXCEL spreadsheet. An "*" indicates values in column were compared against EXCEL spreadsheet — DATE 7-17-98.

Test: AS-Amphipod Sediment
Species: RA-Rhepoxynius abronius
Sample ID:
Start Date: 5/29/98 13:00 End Date: 6/8/98 13:00

Test ID: 590-1
Protocol: PSEP 1995-Puget Sound
Sample Type: SED-Sediment
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Day 0	Day 10 *	Proportion Survived	Number Reburied *	Prop Survivors buried	Prop TEM	No emerged day1	No emerged day2	No.emerged day3	No.emerged day4	No.emerged day5	No.emerged day6	No.emerged day7	No.emerged day8	No.emerged day9	No.emerged day10	Total * emerged
	1	1	MWRC210R1	20	19	0.95	19	1	0.05	0	0	0	0	1	0	0	0	0	0	1
	2	2	MWRC210R1	20	18	0.9	18	1	0.1	0	0	1	1	0	1	2	3	2	3	13
	3	3	MWRC210R1	20	20	1	19	0.95	0.05	0	0	0	0	0	0	0	1	0	0	1
	4	4	MWRC210R1	20	19	0.95	19	1	0.05	0	0	0	1	1	0	0	1	1	0	4
	5	5	MWRC210R1	20	18	0.9	18	1	0.1	0	0	0	0	0	0	0	0	0	1	1
	6	1	MWRC208R1	20	18	0.9	18	1	0.1	0	0	2	2	0	0	0	2	0	1	7
	7	2	MWRC208R1	20	19	0.95	18	0.94736842	0.1	0	0	1	1	0	0	2	0	1	1	6
	8	3	MWRC208R1	20	20	1	19	0.95	0.05	0	0	0	0	0	0	0	0	0	0	0
	9	4	MWRC208R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	0	0	0	0	0
	10	5	MWRC208R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	0	1	0	1	2
	11	1	MWAS022R1	20	19	0.95	18	0.94736842	0.1	2	1	0	2	0	0	1	0	0	2	8
	12	2	MWAS022R1	20	17	0.85	17	1	0.15	0	0	0	0	0	0	1	2	0	1	4
	13	3	MWAS022R1	20	19	0.95	19	1	0.05	0	0	1	0	0	0	0	0	0	2	3
	14	4	MWAS022R1	20	19	0.95	19	1	0.05	1	0	0	0	0	0	0	1	0	0	2
	15	5	MWAS022R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	0	0	0	1	1
	16	1	MWAS024R1	20	18	0.9	18	1	0.1	0	0	0	0	0	0	0	1	0	2	3
	17	2	MWAS024R1	20	18	0.9	18	1	0.1	0	0		1	1	1	2	3	2	2	12
	18	3	MWAS024R1	20	16	0.8	14	0.875	0.3	0	0	1	2	0	0	5	0	4	1	13
	19	4	MWAS024R1	20	14	0.7	14	1	0.3	0	0	0	0	0	0	0	0	2	2	4
	20	5	MWAS024R1	20	16	0.8	16	1	0.2	0	0	0	0	0	0	2	2	0	0	4
	21	1	MWAS025R1	20	16	0.8	16	1	0.2	0	0	0	1	0	0	2	0	0	1	4
	22	2	MWAS025R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	23	3	MWAS025R1	20	17	0.85	17	1	0.15	0	1	0	0	1	4	4	1	0	0	11
	24	4	MWAS025R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	2	2	2	3	9
	25	5	MWAS025R1	20	17	0.85	17	1	0.15	0	1	1	0	0	0	0	1	1	0	4
	26	1	MWAT040R1	20	18	0.9	18	1	0.1	0	0	1	0	0	0	0	0	0	2	3
	27	2	MWAT040R1	20	19	0.95	18	0.94736842	0.1	0	0	0	1	0	0	0	0	1	0	2
	28	3	MWAT040R1	20	19	0.95	19	1	0.05	0	0	0	1	0	0	1	1	1	1	5
	29	4	MWAT040R1	20	20	1	20	1	0	0	0	0	0	0	0	0	1	0	0	1
	30	5	MWAT040R1	20	20	1	19	0.95	0.05	0	0	0	0	0	0	0	0	2	1	3
	31	1	MWAT049R1	20	20	1	20	1	0	0	0	0	0	1	0	1	0	0	2	4
	32	2	MWAT049R1	20	18	0.9	17	0.94444444	0.15	1	0	0	0	0	0	0	0	0	0	1
	33	3	MWAT049R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	34	4	MWAT049R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	35	5	MWAT049R1	20	18	0.9	18	1	0.1	0	0	0	0	0	0	0	0	0	1	1
	36	1	MWAT054R1	20	18	0.9	17	0.94444444	0.15	1	0	0	0	0	0	0	0	1	1	3
	37	2	MWAT054R1	20	17	0.85	17	1	0.15	0	0	0	0	0	0	0	3	0	0	3
	38	3	MWAT054R1	20	19	0.95	18	0.94736842	0.1	0	0	0	0	0	0	0	1	2	1	4
	39	4	MWAT054R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	0	0	1	1	2
	40	5	MWAT054R1	20	18	0.9	18	1	0.1	0	0	1	1	0	1	1	1	0	1	6
	41	1	MWAT039R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	1	0	1	1	3
	42	2	MWAT039R1	20	18	0.9	17	0.94444444	0.15	0	0	0	0	0	0	0	0	2	1	3
	43	3	MWAT039R1	20	19	0.95	19	1	0.05	0	1	0	0	1	2	0	0	0	2	6
	44	4	MWAT039R1	20	19	0.95	19	1	0.05	0	0	1	0	0	1	0	0	0	1	3
	45	5	MWAT039R1	20	19	0.95	18	0.94736842	0.1	1	0	0	1	0	0	0	1	0	0	3
	46	1	MWAT043R1	20	19	0.95	19	1	0.05	0	0	0	0	0	0	0	0	0	0	0

Test: AS-Amphipod Sediment
Species. RA-Rhepoxynius abronius
Sample ID.
Start Date. 5/29/98 13 00 End Date 6/8/98 13 00

Test ID 590-1
Protocol PSEP 1995-Puget Sound
Sample Type. SED-Sediment
Lab ID ORNAS-Northwestern Aquatic Sciences

	47	2	MWAT043R1	20	18	0 9	18	1	0 1	1	0	0	0	0	0	1	0	0	0	2
	48	3	MWAT043R1	20	20	1	20	1	0	0	0	0	0	0	0	1	0	0	3	4
	49	4	MWAT043R1	20	18	0 9	18	1	0 1	0	0	0	2	0	0	0	0	0	0	2
	50	5	MWAT043R1	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	51	1	MWAT048R1	20	16	0 8	16	1	0 2	0	0	0	0	0	0	0	1	0	2	3
	52	2	MWAT048R1	20	20	1	19	0 95	0 05	0	0	0	0	0	0	0	0	0	0	0
	53	3	MWAT048R1	20	19	0 95	19	1	0 05	0	0	0	0	0	0	0	0	0	0	0
	54	4	MWAT048R1	20	16	0 8	15	0 9375	0 25	0	0	0	0	0	0	0	0	0	0	0
	55	5	MWAT048R1	20	19	0 95	19	1	0 05	0	0	1	0	0	2	4	2	2	3	14
	56	1	MWAT052R1	20	18	0 9	18	1	0 1	0	0	1	1	0	0	1	0	0	1	4
	57	2	MWAT052R1	20	20	1	19	0 95	0 05	0	0	0	0	0	0	0	0	0	2	2
	58	3	MWAT052R1	20	17	0 85	17	1	0 15	1	1	0	0	0	0	0	0	0	4	6
	59	4	MWAT052R1	20	19	0 95	18	0.94736842	0 1	0	0	0	0	0	0	0	0	2	2	4
	60	5	MWAT052R1	20	20	1	18	0 9	0.1	0	2	1	0	1	0	0	0	0	2	6
	61	1	CONTROL	20	19	0 95	19	1	0 05	1	0	0	2	0	0	2	2	2	2	11
	62	2	CONTROL	20	20	1	20	1	0	0	0	0	1	1	2	1	1	1	1	8
	63	3	CONTROL	20	20	1	20	1	0	0	0	0	0	0	0	0	0	0	0	0
	64	4	CONTROL	20	20	1	20	1	0	0	0	0	1	1	0	2	2	1	2	9
	65	5	CONTROL	20	20	1	20	1	0	0	0	0	1	0	0	1	0	1	1	4
	66	1	MWRC209R1	20	20	1	20	1	0	0	0	2	0	0	0	0	0	0	0	2
	67	2	MWRC209R1	20	20	1	20	1	0	0	0	1	1	0	0	0	0	1	0	3
	68	3	MWRC209R1	20	20	1	19	0 95	0.05	0	0	0	0	0	0	0	0	0	0	0
	69	4	MWRC209R1	20	19	0.95	19	1	0.05	0	0	0	1	0	0	0	0	0	2	3
	70	5	MWRC209R1	20	18	0 9	18	1	0.1	0	0	0	1	0	0	0	0	0	0	1

Comments:

Page 1 of 1 Lab Ref No

Chain of Custody Record

FOSTER WHEELER ENVIRONMENTAL CORPORATION
10900 NE 8th Street • Bellevue, WA 98004
(206) 688-3700 • Fax (206) 688-3952

~~Alaska Pulp Corporation~~
~~Bay OU RI/FS Studies~~
~~Sitka, Alaska~~ Middle Waterway

FW Project No: ~~1442.0000.2000~~ 1697.0010.00016

Sampling Date: 5/15/98
Shipping Date: 5/16/98
Shipping Ref.:

Analytical Laboratory: ~~Columbia Analytical Services (360 577 7222)~~ NW Aquatic
Laboratory Contact: ~~Abbie Spielman~~ P.O. No.:
Reports to be Sent to: ~~Brenda Steele (FW)~~ Kata Ritenburg
Address/Phone No.: ~~206 688-3849~~ 425-688-3700

Sampler(s) (printed name): Carol Hutzler
Sampler(s) (signature): Carol Hutzler
Special Instructions:

SAMPLE IDENTIFICATION	TIME COLLECTED	NO OF CONTAINERS, SIZE & TYPE	PRESERVATIVE	MATRIX	SAMPLE TYPE Composite	SAMPLE TYPE Grab	Dioxins/Furans 8290	Metals PSEP 6010/7000/200.8 (As,Ba,Cd,Cr,Pb,Se,Ag,Cu,Mn,Ni,Zn)	Sediment Conventionals PSEP Methods (Total Solids,Total Sulfides,Acid Volatiles Sulfides,TOC, Ammonia as Nitrogen,Grain Size,BOD,COD)	Guaiacols EPA 1653	Resin Acids, Fatty Acids, Bleach Plant Derivatives NCASI RA/FA-85.01 mod.	Lipids	REMARKS
MWAS024R1	11:00	6-32oz	None	Sed	X								✓ Bioassays Suite in Contract for MW Project Amphipod + Echinoderm Hold for possible Neanthes NASH 0691F
MWAS025R1	14:37	6-32oz	None	Sed	X								✓ 0692F
MWAS022R1	16:10	6-32oz	None	Sed	X								✓ 0690F

Turnaround Time: ☐ Standard ☐ 1 Week ☐ 4 Work Day ☐ 3 Work Day ☐ 2 Work Day ☐ 24 Hour

Sample Receipt
Total # Containers Recvd: 18
COC Seals Present? no
COC Seals Intact?
Received Cold? yes
Received Intact? yes
Received Via: FedEx

Relinquished by (signature): Carol Hutzler
Date: 5/15/98 Time: 22:05
Received by (signature): [illegible]
Date: 5/15/98 Time: 15:00

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

MultiChem
ANALYTICAL SERVICES

5960 Naches Ave. SW Suite 101 Kenton, WA 98055
(800) 609 0580 • (425) 228-8335 • FAX (425) 228-8336

LAB NUMBER:

DATE: 5/18/98

COMPANY: Foster Wheeler Envr
ADDRESS: 10900 NE 8th St Ste 1300
Bellevue, WA

PHONE: (425) 688 3700 FAX (425) 688 3952
PROJ. MGR / CONTACT: Kula Rutenberg
PROJECT NUMBER: 1699.0010.0006
PROJECT NAME:
DISPOSAL: ☐ MAS ☑ HOLD ☐ RETURN

FUELS | ORGANIC COMPOUNDS | METALS | TCLP | OTHER

Bioassay per Contract

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	
MWAT054K1 5-32 oz	5/18/98	11:91	Sed	0723	F
MWAT049K1 5-32 oz	5/18/98	13:50	Sed	0722	F
MWAT040K1 5-32 oz	5/18/98	11:30	Sed	0721	F

SAMPLE RECEIPT		TAT
TOTAL # OF CONTAINERS	☐ YES ☐ NO	☐ 24 HOURS
COC SEALS PRESENT?	☐ YES ☒ NO	☐ 48 HOURS
COC SEALS INTACT?	☐ YES ☐ NO	☐ 72 HOURS
RECEIVED COLD?	☒ YES ☐ NO	☐ 7 DAYS
RECEIVED INTACT?	☒ YES ☐ NO	☐ SP
RECEIVED VIA:	Fed Ex	☐ STANDARD

SPECIAL INSTRUCTIONS/COMMENTS:
Amphipod or Larval → Hold Sed for possible Neanthes

*METALS NEEDED:

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
SIGNATURE: Carol Hutley	SIGNATURE:	SIGNATURE:
PRINT NAME: CAROL HUTLEY	PRINT NAME:	PRINT NAME:
DATE: 5/19/98 TIME: 11:40	DATE: TIME:	DATE: TIME:
COMPANY:	COMPANY:	COMPANY:
RECEIVED BY:	**RECEIVED BY:**	**RECEIVED BY:**
SIGNATURE: R S Caldwell	SIGNATURE:	SIGNATURE:
PRINT NAME: Richard S. Caldwell	PRINT NAME:	PRINT NAME:
DATE: 5/20/98 TIME: 15:20	DATE: TIME:	DATE: TIME:
COMPANY: NW Aquatic	COMPANY:	COMPANY:

MAS USE ONLY: SUBCONTRACT LAB: PO #:

MultiChem
ANALYTICAL SERVICES

560 Naches Ave. SW Suite 101 Renton, WA 98055
(800) 609 0580 • (425) 228-8335 • FAX (425) 228-8336

LAB NUMBER:

DATE: 5/19/98
PAGE: 1 of 1

COMPANY: Foster Wheeler Envr
ADDRESS: 10900 NE 8th St Ste 1300
Bellevue, WA

PHONE: (425) 688 3100 FAX (425) 688 3952
PROJ MGR / CONTACT: Kate Pilenberg
PROJECT NUMBER: 1690.0010.02C06
PROJECT NAME: Middle Waterway
DISPOSAL: ☐ MAS ☒ HOLD ☐ RETURN

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	FUELS	ORGANIC COMPOUNDS	METALS	TCLP	OTHER	Bioassay to Contract Lab		
MWAT03R1												
5-32 oz	5/19/98	15:40	Sed	0727F						X	0727	F
MWAT07R1 (48R1)												
5-32 oz	5/19/98	16:50	Sed	0729F						X	0729	F
MWAT043R1												
5-32 oz	5/19/98	18:20	Sed	0728F						X	0728	F
MWAT052R1												
5-32 oz	5/19/98	18:50	Sed	0730F						X	0730	F

SAMPLE RECEIPT			TAT:
TOTAL # OF CONTAINERS:	☐ YES	☐ NO	☐ 24 HOURS
COC SEALS PRESENT?	☐ YES	☐ NO	☐ 48 HOURS
COC SEALS INTACT?	☐ YES	☐ NO	☐ 72 HOURS
RECEIVED COLD?	☐ YES	☐ NO	☐ 7 DAYS
RECEIVED INTACT?	☐ YES	☐ NO	☐ SP
RECEIVED VIA:			☐ STANDARD

SPECIAL INSTRUCTIONS/COMMENTS
Amphipod + larval bioassay per contract
Hold sediment for potential recollection

collection time on chain MWAT03R1 is 15:40, should be 13:40
Jar #3 of MWAT07R1 was broken
Jar #3 of MWAT052R1 was broken
METALS NEEDED: collect TIMES LEAD
MWAT052R1 is 18:50 [illegible] 20:00

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
SIGNATURE: Carol Hurley	SIGNATURE:	SIGNATURE:
PRINT NAME: CAROL HURLEY	PRINT NAME:	PRINT NAME:
DATE: 5/19/98 TIME: 8:25AM	DATE: TIME:	DATE: TIME:
COMPANY:	COMPANY:	COMPANY:
RECEIVED BY:	RECEIVED BY:	RECEIVED BY:
SIGNATURE: [illegible]	SIGNATURE:	SIGNATURE:
PRINT NAME: Greg A. Bohler	PRINT NAME:	PRINT NAME:
DATE: 5/21/98 TIME: 1500	DATE: TIME:	DATE: TIME:
COMPANY: Northwest Aquatic	COMPANY:	COMPANY:

MAS USE ONLY: SUBCONTRACT LAB: PO #:

5-21-98

Chain of Custody Record
Request for Analysis

Page 1 of 1 Lab Ref No

FOSTER WHEELER ENVIRONMENTAL CORPORATION
10900 NE 8th Street • Bellevue, WA 98004
(206) 688-3700 • Fax (206) 688-3952

Project Name: Middle WATERWAY
Project Address: 10900 NE 8th St
Bellevue, WA 98004

FW Project No: 1699.0010.0005

Sampling Date: 5-22-98
Shipping Date:
Shipping Ref:

Analysis Laboratory: Northwestern Aquatic Sciences
Laboratory Contact: Dick Caldwell P.O. No.:
Reports to be Sent to: Gary Braun
Address/Phone No.: 425-688-3700 Fax 425-688-3951

Sampler(s) (printed name): D. Brent Jones
Sampler(s) (signature): D. Brent Jones
Special Instructions:

Hazard ID:
- [x] Nonhazardous
- [ ] Hazardous:
  - [ ] Reactive
  - [ ] Toxic
  - [ ] Flammable
  - [ ] Irritant
  - [ ] Infectious
  - [ ] Radioactive

Sample Disposal Instructions:
- [x] Lab disposal
- [ ] Return to FWENC
- [ ] Hold for pickup (w/l call)

ANALYSES REQUEST (circle appropriate method number)

SAMPLE IDENTIFICATION	TIME COLLECTED	NO OF CONTAINERS, SIZE & TYPE	PRES ERVATIVE	MATRIX	SAMPLE TYPE Composite	SAMPLE TYPE Grab	Method Standard	EXTRACTION	TCLP (1311)	Other	CLP Data Pkg.: Other	Halogenated Volatiles 8010, 601, 502.1, CLP	Aromatic Volatiles 8020, 602, 502.2, 503.1, CLP	BETX Only 8020, 602, CLP	GC/MS Vol. 8240, 8260, 624, 524.1, 524.2, CLP	GC/MS BNA (semi-vol.) 8250, 8270, 625, 525, CLP	Pesticides & PCBs 8080, 8081, 608, 505, 508, CLP	PCBs Only 8080, 608, 508A, CLP	HPLC PNA/PAHs 8310, 610	Ordnance/Explosives HPLC 8330 mod, GC/ECD	TPH-HCID AK, OR, WA, 418.1	TPH-G AK, OR, WA, 8015 mod	TPH-D AK, OR, WA, 8015 mod	Lead 6010, 7420, 7421	Priority Poll. Metals (13) 6010 & 7000 Series CLP	TCL Metals (23) 6010 & 7000 Series, CLP	TCLP 1311 (metals, VOAs, SVOAs, Pest., Herb.)	BIOASSAY (as per Contract)						REMARKS
~~208RC 087~~	1415	(6) 32oz glass																																		
MWRC208RI	~~1520~~	↓	none	Sediment	X			NAC #						0749F														X								cool to 4°C
MWRC209RI	1530		↓	↓	↓									0750F														X								↓
MWRC210RI	1600													0751F														X								

Turnaround Time:
- [x] Standard
- [ ] 1 Week
- [ ] 72 Hours
- [ ] 48 Hours
- [ ] 24 Hours
- [ ] Other

Sample Receipt
Total # Containers Recvd
COC Seals Present?
COC Seals Intact?
Received Cold?
Received Intact?
Received Via:

Relinquished by: (signature) D. Brent Jones
Date: 5/22/98 Time:
Received by: (signature) [illegible]
Date: 5-28-98 Time: 10:30

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

ADM409—10/96

APPENDIX III

RAW DATA - REFERENCE TOXICANT TEST

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-897 Client QC TEST Investigator

Test Type (rangefinding/definitive) Test Length (hr) 96

Species RHEPOXYNIUS ABRONIUS

STUDY MANAGEMENT

Client: QC TEST

Client's Study Monitor: NA

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: NEWPORT LABORATORY

Laboratory's Study Personnel:

Proj. Man./Study Dir. R.S. CALDWELL

QA Officer L.K. NEMETH

1. [illegible] 2. [illegible]

3. [illegible] 4.

Study Schedule:

Test Beginning: 5-29-98 1500 Test Ending: 6-2-98 1420

TEST MATERIAL MALLINCKRODT LOT # TNZ

Description: CADMIUM AS $CdCl_2 \cdot 2\frac{1}{2} H_2O$ (1.0 mg/mL) STOCK PREP'D: 7-16-97

NAS Sample No.:				
Date of Collection:				
Date of Receipt:				
Temperature (°C):				
Dissolved oxygen (mg/L):				
Conductivity (umhos/cm):				
pH:				
Hardness (mg/L):				
Alkalinity (mg/L):				
:				

DILUTION WATER

Description: YAQUINA BAY SEAWATER

Date of Preparation/Collection: 5-23-98

Water Quality: Cond. (umhos/cm) — Salinity (ppt) 28.0 pH 7.5

Hardness (mg/L as $CaCO_3$) — Alkalinity (mg/L as $CaCO_3$) —

Treatments: AERATED, FILTERED TO 0.4 um, SALINITY ADJUSTED W/ MILLI-Q (D.I. WATER)

TEST ORGANISMS

Species: RHEPOXYNIUS ABRONIUS Age: Size:

Source: Parametrix, West Beach, Whidbey Island, WA

Acclimation Data: Collected 5-25-98

Date	Temp (°C)	DO (mg/L)	pH	Sal/Cond	Comments
5-27-98	7.8	2.6	7.1	30.0	[illegible] 5-27-98
5-28-98	15.9	6.7	7.3	30.0	
5-29-98	15.9	7.9	7.7	29.0	
Mean	13.2	5.7	7.4	29.7	
S.D.	4.7	2.8	0.3	0.6	
(N)	3	3	3	3	

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-897 Client QC TEST Investigator

TEST PROCEDURES AND CONDITIONS

Test concentrations: (50% series recommended) 10, 3, 1, 0.3, 0.1, Ø mg/L

Test chambers: 250 mL BEAKERS Test volume: 100 mL

Replicates/treatment: (2) 2 Organisms/treatment: (20) 20 (10/REPL)

Test water changes: NONE Aeration during test: NONE

Feeding: None Photoperiod: ~~16L:8D~~ Constant light BC

Temperature: 15 ± 1

Duration: 24-hr, 48-hr, 96-hr Renewal: NONE

Beaker placement: Stratified randomization

Randomization chart:

A	Ø	10	0.3	0.1	3.0	1.0
B	10	1.0	Ø	0.1	0.3	3.0
C						
D						

MISCELLANEOUS NOTES

TEST SOLUTION PREP:

TEST CONC. (mg/L)	ML'S OF Cd STOCK (1.0 mg/ML) PER 200 ML
10	2.0
3.0	0.6
1.0	0.2
0.3	0.06
0.1	0.02
Ø	Ø

SOL'N THEN BROUGHT UP TO VOLUME IN GRADUATED CYLINDER W/ DIL'N WATER.

-29-98 BC

Rev. 2/97

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-897 Client QC TEST Investigator

DAY 0 (5/29/98) BC

	Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1.	10	15.5	8.0	27.0		7.7			10	10
2.	3.0	15.6	8.0	27.0		7.6			10	10
3.	1.0	15.7	8.0	27.0		7.7			10	10
4.	0.3	15.6	8.0	27.0		7.6			10	10
5.	0.1	15.6	8.0	27.0		7.6			10	10
6.	0	15.6	8.0	27.0		7.5			10	10

DAY 1 (5/30/98) [illegible]

	Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1.	10	15.0	7.0	28.0		7.7			10	10
2.	3.0	15.0	6.8	28.0		7.7			10	10
3.	1.0	15.0	6.9	28.0		7.7			10	10
4.	0.3	15.0	7.1	28.0		7.7			10	10
5.	0.1	15.1	7.0	28.0		7.7			10	10
6.	0	15.0	6.8	28.0		7.6			10	10

DAY 2 (5/31/98) [illegible]

	Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1.	10	14.9	6.6	27.5		7.8			0 (100)	0 (100)
2.	3.0	15.0	6.1	27.5		7.7			3 (70)	4 (60)
3.	1.0	14.9	6.0	27.5		7.7			7 (30)	4 (60)
4.	0.3	14.9	5.4	27.5		7.7			9 (10)	9 (10)
5.	0.1	14.9	5.6	27.5		7.8			10	10
6.	0	14.9	5.1	27.5		7.6			10	10

DAY 3 (6/1/98) [illegible]

	Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1.	10								0	0
2.	3.0	15.0	6.2	29.0		7.6			0 (30)	0 (40)
3.	1.0	15.1	5.9	27.5		7.7			0 (70)	0 (40)
4.	0.3	15.0	5.5	27.5		7.5			9	9
5.	0.1	15.0	5.6	29.0		7.5			10	10
6.	0	15.0	4.2	29.0		7.4			10	10

DAY 4 (6/2/98) [illegible]

	Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1.	10								0	0
2.	3.0								0	0
3.	1.0								0	0
4.	0.3	14.8	5.2	29.0		7.4			3 (60)	3 (60)
5.	0.1	14.4	4.8	29.0		7.4			4 (60)	5 (50)
6.	0	14.9	4.2	29.0		7.2			8 (20)	8 (20)

Remarks:

Rev. 2/97

Acute 96-hr Toxicity Test-96 Hr Survival

Start Date:	5/29/98 15:00	Test ID:	999-897	Sample ID:	REF-Ref Toxicant
End Date:	6/2/98 14:20	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	CDCL-Cadmium chloride
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	RA-Rhepoxynius abronius
Comments:					

Conc-mg/L	1	2
D-Control	0.8000	0.8000
0.1	0.4000	0.5000
0.3	0.3000	0.3333
1	0.0000	0.0000
3	0.0000	0.0000
10	0.0000	0.0000

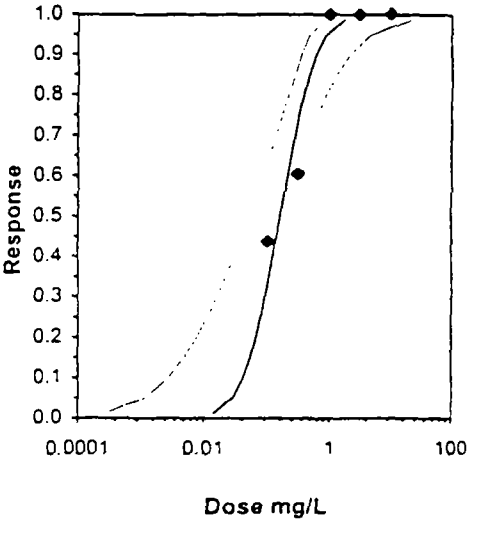
			Transform: Arcsin Square Root					Number	Total
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
D-Control	0.8000	1.0000	1.1071	1.1071	1.1071	0.000	2	4	20
0.1	0.4500	0.5625	0.7351	0.6847	0.7854	9.685	2	11	20
0.3	0.3167	0.3958	0.5976	0.5796	0.6155	4.241	2	13	19
1	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
3	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
10	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.20229	0.63652	0.95472	3.44987	0.2	2.42313	11.3449	0.49	-0.8018	0.45407	6
Intercept	6.76585	0.46117	5.86195	7.66976							
TSCR	0.21322	0.09094	0.03497	0.39146							

Point	Probits	mg/L	95% Fiducial Limits	
EC01	2.674	0.01386	0.00024	0.04531
EC05	3.355	0.02827	0.00121	0.0732
EC10	3.718	0.04133	0.00285	0.09518
EC15	3.964	0.0534	0.00506	0.11413
EC20	4.158	0.06547	0.00795	0.13235
EC25	4.326	0.07797	0.01167	0.15082
EC40	4.747	0.1211	0.02999	0.21466
EC50	5.000	0.15782	0.05145	0.27297
EC60	5.253	0.20569	0.08502	0.36038
EC75	5.674	0.31948	0.17152	0.65336
EC80	5.842	0.38048	0.21464	0.87348
EC85	6.036	0.46643	0.26956	1.26718
EC90	6.282	0.60269	0.34563	2.1022
EC95	6.645	0.88116	0.47622	4.66997
EC99	7.326	1.79682	0.8085	22.4288



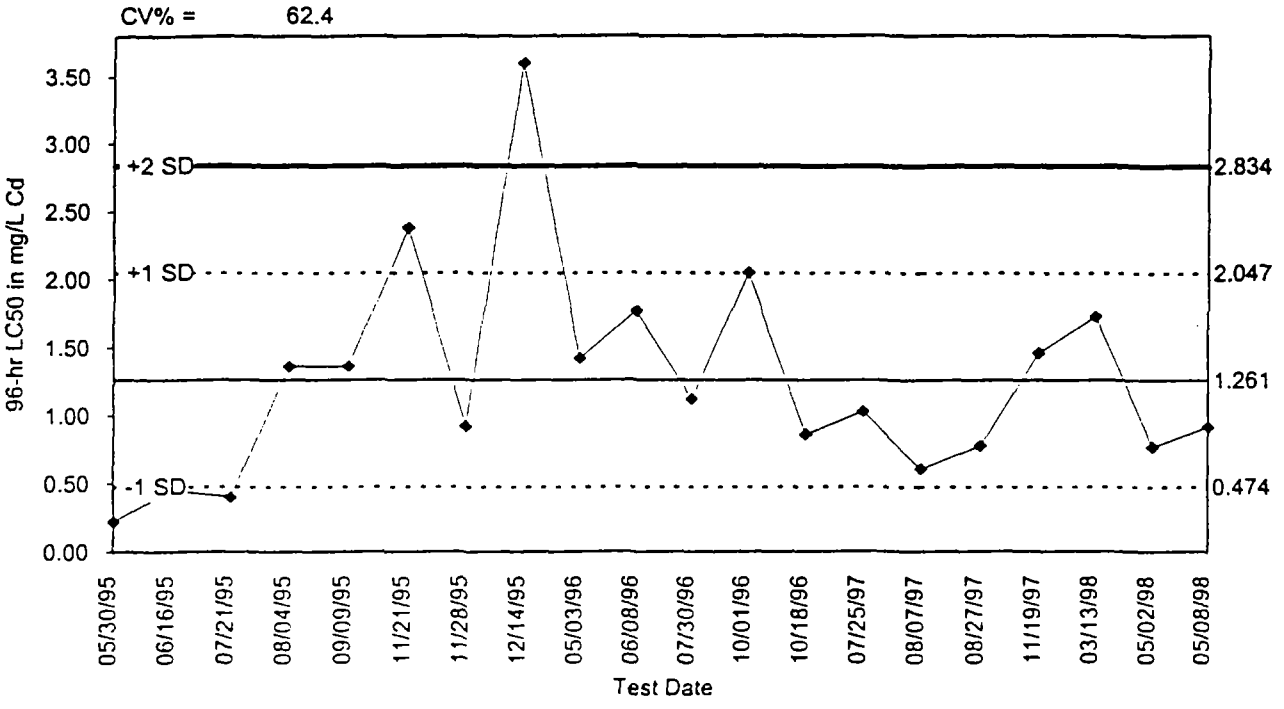
ToxCalc v5.0.15N

Test: AT-Acute 96-hr Toxicity Test
Test ID: 999-897
Species: RA-Rhepoxynius abronius
Protocol: EPAA 91-EPA Acute
Sample ID: REF-Ref Toxicant
Sample Type: CDCL-Cadmium chloride
Start Date: 5/29/98 15:00
End Date: 6/2/98 14:20
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	10				8	
	2	2	D-Control	10				8	
	3	1	0.100	10				4	
	4	2	0.100	10				5	
	5	1	0.300	10				3	
	6	2	0.300	9				3	
	7	1	1.000	10				0	
	8	2	1.000	10				0	
	9	1	3.000	10				0	
	10	2	3.000	10				0	
	11	1	10.000	10				0	
	12	2	10.000	10				0	

Comments:

Reference toxicant test control chart - Rhepoxynius abronius - last 20 points



MLR
6-16-98

ToxCalc v4.0

NAS# 0743F

Amphipod Collection Data Sheet	
Sold to	Northwestern Aquatic Sciences Attn: Michele Redmond 5144 Yaquina Bay Road Newport, OR 97365
Species	Rhepoxynius abronius
Field Collection Notes	
Location	West Beach, Whidbey Island, WA
Data Collected	5/25/98
Number Collected	4,000 +
Temperature	11 °C
pH	7.8
Dissolved Oxygen	94 %
Salinity	30 ‰
Notes	
Holding Conditions	
Temperature	12 °C
Notes	
Shipping Date	5/26/98

TOXICITY TEST NO. 590-3

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 590-3
Title: *Mytilus* sp. larval sediment toxicity test.
Protocol: NAS-XXX-CG4, June 20, 1990 (Revision 2, February 10, 1997). Complies with: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP 1995), with modifications as specified by the Puget Sound Dredged Disposal Analysis Program.

STUDY MANAGEMENT

Study Sponsor: Foster Wheeler Environmental, 10900 N.E. 8th St., Suite 1300, Bellevue, WA 98004
Sponsor's Study Monitor: Mr. Gary Braun
Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, Oregon 97365.
Test Location: Newport Laboratory.
Laboratory's Study Personnel: R.S. Caldwell, Ph.D., Proj. Mngr./Study Dir.; L.K. Nemeth, B.A., QA Officer; M.S. Redmond, M.S., Aq. Toxicol.; G.J. Irissarri, B.S., Aq. Toxicol.; B. Crowe, B.S., Sr. Tech.
Study Schedule:
Test Beginning: 6-4-98, 1700 hrs.
Test Ending: 6-6-98, 1700 hrs.
Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.
Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).
Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Test Sediments: Unidentified marine sediments. Details are as follows:

NAS Sample No.	0690F	0691F	0692F	0721F	0722F
Foster Wheeler Sample No.	MWAS022R1	MWAS024R1	MWAS025R1	MWAT040R1	MWAT049R1
Collection Date	5-15-98	5-15-98	5-15-98	5-18-98	5-18-98
Receipt Date	5-18-98	5-18-98	5-18-98	5-20-98	5-20-98
Interstitial salinity (ppt)	28.5	27.0	28.0	27.0	28.0

NAS Sample No.	0723F	0727F	0728F	0729F	0730F
Foster Wheeler Sample No.	MWAT054R1	MWAT039R1	MWAT043R1	MWAT048R1	MWAT052R1
Collection Date	5-18-98	5-19-98	5-19-98	5-19-98	5-19-98
Receipt Date	5-20-98	5-21-98	5-21-98	5-21-98	5-21-98
Interstitial salinity (ppt)	*	25.0	26.0	24.0	24.0

NAS Sample No.	0749F	0750F	0751F
Foster Wheeler Sample No.	MWRC208R1	MWRC209R1	MWRC210R1
Collection Date	5-22-98	5-22-98	5-22-98
Receipt Date	5-28-98	5-28-98	5-28-98
Interstitial salinity (ppt)	28.0	29.0	28.0

*Insufficient water available for salinity measurement.

Storage: Stored locked at 4°C in the dark in capped containers until used.
Treatments: Homogenized.

TEST WATER

Source: Yaquina Bay, Oregon
Date of Collection: 6-3-98
Water Quality: Salinity 28.0 ppt; pH 7.9
Pretreatment: Filtered to ≤0.40 µm and aerated.

TEST ORGANISMS

Species: *Mytilus* sp., mussel.
Age: 1.0 hr post-fertilization
Source: Yaquina Bay, Oregon.
Acclimation: Adults were collected 6-4-98 and used immediately.
Source of Gametes: 8 females, 4 males.

TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. See the test protocol (Appendix I) for a more detailed description of the test procedures used in this study.

Test Chambers: 1 L covered borosilicate glass beakers
Test Volumes: 18 g of test sediment brought up to a final volume of 900 ml with test water. Sediment was allowed to settle for the normal period of 4 hours as specified in the protocol.
Replicates/Treatment: 5 (plus a 6th water quality replicate).
Sediment Salinity Adjustment: None required.
Initial Concentration of Test Organisms: 32.2/ml
Water volume changes per 24 hours: None
Volume of Subsamples Taken for Counting: 10 ml
Aeration: Yes by slow bubbling at least 2 cm above the sediment surface.
Feeding: None
Acceptance Criteria: The percent normal in the seawater control must be ≥70%.
Effects Criteria: The effects criteria used were: 1) mortality; 2) abnormal development to the fully-shelled stage; and 3) the combined mortality/abnormality endpoint. Normal development is defined as transformation to the fully shelled, straight-hinged, D-shaped prodissoconch I stage. Data collected were: 1) the initial embryo density; 2) the number of abnormal larvae observed; and 3) the number of normal larvae observed. The results were expressed as: 1) percent abnormality; 2) percent mortality; 3) combined percent mortality and abnormality; and 4) normalized (to the seawater control) a) percent mortality and b) combined percent mortality and abnormality.
Water Quality and Other Test Conditions: The temperature, dissolved oxygen, salinity, and pH were measured in the water quality replicate test chamber daily. Ammonia-N and sulfide were measured in the overlying water of the water quality replicate test chamber on days zero and 2. Sulfide and ammonia-N analyses were by the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis. The values of individual water quality measurements are to be found in the raw data (Appendix II). The means, and minimum and maximum values for the water quality parameters during the test are listed in Table 1. The photoperiod was 14:10, L:D.

DATA ANALYSIS METHODS

Prior to issuance of the July 1995 revision of the PSEP recommended guidelines for conducting laboratory bioassays, no specific guidance was given for the computation of endpoints. All three standard endpoints, percent abnormal, percent combined mortality/abnormality, and percent mortality have occasionally been computed both with, and without, normalization for the seawater control. Endpoints in this report have been computed according to the following formulas:

PABN (Percent Abnormality) = 100*(A/T)
PABND (Combined Percent Mortality/Abnormality) = 100*((I-N)/I)
PMORT (Percent Mortality) = 100*((I-T)/I)

where the following are counts per 10 ml subsample:

N = normal larvae counted
A = abnormal larvae counted
T = N+A (total larvae counted)
I = number of inoculated embryos (from average of zero time counts)
TS = average of total larvae counted in seawater controls
NS = average of normal larvae counted in seawater controls

The means and standard deviations were then calculated for each treatment level. The statistical software employed for these calculations was Microsoft Excel Ver. 5.0. Values of the five endpoints for the test sediments were statistically compared against each of the three reference sediments using ToxCalc v5.0.15N. An arcsine square root transformation was performed on proportional data before analysis. Following transformation and determination of normality and homogeneity of variances, one-tailed homoscedastic t-tests were conducted at the 0.10 level of significance.

PROTOCOL DEVIATIONS

1. An inoculation volume (10 ml) higher than the specified 1.0 ml was used, with a more dilute larval stock. This minor deviation is unlikely to have had any adverse effect on the test results.

2. Temperature was recorded as 14.9 °C in two monitoring beakers on the last day of the test. This minor deviation (0.1 °C) should not adversely impact the test results.

REFERENCE TOXICANT TEST

The reference toxicant test is a standard multi-concentration toxicity test using copper as $CuSO_4 \bullet 5H_2O$ to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-904
Reference Toxicant and Source: Copper as $CuSO_4 \bullet 5H_2O$, Argent Lot #0195, 1.0 mg/ml stock prepared 8-2-96.
Test Date: 6-4-98
Dilution Water Used: Yaquina Bay, Oregon, seawater
Result: 48-hr EC50, 11.4 µg/L Cu. This result is within the laboratory's control chart warning limits (8.70 to 11.8 µg/L Cu.

RESULTS AND CONCLUSIONS

A total of 10 test replicate subsamples were recounted (QC counts) by a second investigator as a check on the acceptability of the initial counts (Appendix II). In all instances the QC counts were very close (coefficients of variation from 0 to 3 for counts of normal larvae) to the initial counts and were considered acceptable.

The test was considered to be acceptable because 82.5% of the inoculated embryos (32.2/ml based on average counts of zero time samples) produced normal larvae in the seawater controls. This exceeds the test acceptance criterion of ≥70% as specified in the protocol. In addition, the results of the reference toxicant test were acceptable compared with the laboratory's historical data for this species.

Water quality data collected during the test exposure in water quality monitoring beakers for each treatment are summarized in Table 1. A detailed tabulation of the water quality results by sample and date can be found in the raw data (Appendix II). All water quality measurements of temperature, dissolved oxygen, and pH were within the protocol specified ranges. Sulfides were not detected (detection limit, 0.01 mg/L) in the overlying water of the water quality monitoring beakers either at the beginning or end of the test. Total ammonia-N was detected at only 0.2 mg/L in the overlying water of one water quality monitoring beaker at the beginning of the test, with

none detected in the remaining water quality beakers (detection limit = 0.2 mg/L), and reached a maximum of 0.3 mg/L at the end of the test.

The means and standard deviations of the biological responses for each sediment are summarized in Table 2. Detailed data organized by sample and replicate, including the larval counts, all calculated endpoints, summary statistics and hypothesis testing, for all calculated endpoints are given in the raw data (Appendix II).

For sample MWAS022R1, percent mortality (29.0%), combined mortality and abnormality (33.6%), and normalized combined mortality and abnormality (19.6%) were significantly greater than that in reference MWRC208R1 (19.8%, 23.6%, 7.5%), and MWRC209R1 (19.8%, 24.4%, 8.4%).

For sample MWAT054R1, percent mortality (26.8%), combined mortality and abnormality (32.1%), and normalized percent mortality (17.5%) were significantly greater than that in reference MWRC208R1 (19.8%, 23.6%, 9.6%), and MWRC209R1 (19.8%, 24.4%, 9.5%). Percent abnormality for this sample (7.2%) was also significantly greater than that in MWRC208R1 (4.7%).

For sample MWAT048R1, percent mortality (25.0%), combined mortality and abnormality (29.5%), normalized percent mortality (15.4%), and normalized combined mortality and abnormality (14.6%) were significantly greater than that in reference MWRC208R1 (19.8%, 23.6%, 9.6%, 7.5%). The combined and normalized combined endpoints for this sample were also significantly greater than the values for MWRC209R1 (24.4%, 8.4%).

Sample MWAT052R1 showed significantly higher percent mortality (26.1%) than reference MWRC208R1 (19.8%).

The only other significant result was that the seawater control showed significantly higher percent abnormality (6.9%) than reference MWRC208R1 (4.7%) or in MWRC210R1 (5.1%).

STUDY APPROVAL

Michele S Redmond for Richard S Caldwell 7-28-98
Project Manager/Study Director Date

Michele S Redmond for Richard S Caldwell 7-28-98
Manager, Toxicology Date

Quality Assurance Unit 7-28-98
Date

Table 1. Summary of water quality conditions during the tests of mussel, *Mytilus* sp., larvae exposed to marine sediments.

Parameter	Mean ± SD	Minimum	Maximum	N
Temperature (°C)	15.1 ± 0.1	14.9	15.2	42
Dissolved Oxygen (mg/L)	7.1 ± 1.3	4.8	8.2	42
Salinity (ppt)	27.6 ± 0.7	27.0	29.0	42
pH	7.8 ± 0.1	7.6	8.0	42
Total Sulfide (mg/L)	--	<0.01	<0.01	28
Total Ammonia-N (mg/L)	--	<0.2	0.3	28

Table 2. Means and standard deviations (n=5) of responses of mussel, *Mytilus* sp., larvae exposed to marine sediments.

Sample Description	Percent mortality	Percent abnormality	Combined percent mortality & abnormality	Normalized percent mortality	Normalized combined percent mortality & abnormality
Seawater Control	11.3 ± 7.7	6.9 ± 1.6 ac	17.5 ± 6.4	0.0 ± 8.7	0.0 ± 7.7
MWAS022R1 (NAS #0690F)	29.0 ± 12.0 ab	6.2 ± 2.3	33.6 ± 9.5 ab	20.0 ± 13.6	19.6 ± 11.5 ab
MWAS024R1 (NAS #0691F)	18.5 ± 7.8	4.0 ± 1.5	21.8 ± 6.5	8.1 ± 8.7	5.3 ± 7.9
MWAS025R1 (NAS #0692F)	25.5 ± 8.3	2.6 ± 1.5	27.5 ± 7.5	16.0 ± 9.4	12.1 ± 9.1
MWAT040R1 (NAS #0721F)	22.3 ± 7.4	5.2 ± 1.2	26.4 ± 6.7	12.4 ± 8.3	10.8 ± 8.1
MWAT049R1 (NAS #0722F)	18.5 ± 5.0	4.6 ± 2.1	22.2 ± 5.2	8.1 ± 5.6	5.7 ± 6.3
MWAT054R1 (NAS #0723F)	26.8 ± 7.1 ab	7.2 ± 3.2 a	32.1 ± 7.2 ab	17.5 ± 8.0 ab	17.7 ± 8.7 ab
MWAT039R1 (NAS #0727F)	19.8 ± 4.6	4.4 ± 1.7	23.3 ± 5.0	9.6 ± 5.1	7.1 ± 6.1
MWAT043R1 (NAS #0728F)	18.3 ± 3.7	5.2 ± 2.2	22.6 ± 3.6	7.9 ± 4.1	6.2 ± 4.3
MWAT048R1 (NAS #0729F)	25.0 ± 7.2 a	6.0 ± 2.0	29.5 ± 5.9 ab	15.4 ± 8.1 a	14.6 ± 7.2 ab
MWAT052R1 (NAS #0730F)	26.1 ± 9.0 a	3.9 ± 1.9	29.0 ± 8.4	16.7 ± 10.2	14.0 ± 10.2
MWRC208R1 (NAS #0749F)	19.8 ± 2.5	4.7 ± 1.4	23.6 ± 1.5	9.6 ± 2.8	7.5 ± 1.8
MWRC209R1 (NAS #0750F)	19.8 ± 5.0	5.8 ± 1.2	24.4 ± 4.2	9.5 ± 5.6	8.4 ± 5.1
MWRC210R1 (NAS #0751F)	23.6 ± 7.7	5.1 ± 1.8	27.5 ± 6.1	13.8 ± 8.7	12.2 ± 7.4

[a] Significantly different ($p \leq 0.10$) from reference sediment MWRC208R1.
[b] Significantly different ($p \leq 0.10$) from reference sediment MWRC209R1.
[c] Significantly different ($p \leq 0.10$) from reference sediment MWRC210R1.

APPENDIX I

PROTOCOL

TEST PROTOCOL

BIVALVE LARVAL SEDIMENT BIOASSAY

1. INTRODUCTION:

1.1 Purpose of Study: The purpose of this study is to identify test sediments that are toxic to bivalve larvae.

1.2 Summary of Method: The 48- to 60-hr static test is performed using newly fertilized embryos of the Pacific oyster, *Crassostrea gigas* or blue mussel, *Mytilus* sp. Eighteen grams of test sediment are suspended in 900 mL of test water are vigorously mixed for 10 sec in the 1 L glass test vessels to produce the test medium. After 4 hr, the test containers are inoculated with <2-hr-old embryos at a level sufficient to yield a final concentration of 20-40 per ml. Five replicates are used for each treatment, reference, and control sediment (A sixth replicate is used only for water quality measurements). Mortality, abnormal development, and combined mortality/abnormality during exposure are the response criteria used. The mean ± S.D. for each treatment and test endpoint is given in the final report. Between-treatment comparisons may be made with Student's t-test, or by using an analysis of variance with an appropriate *post-hoc* test.

2. STUDY MANAGEMENT:

2.1 Sponsor's Name and Address:
_____
_____
_____

2.2 Sponsor's Study Monitor:
_____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
Yaquina Bay Road
P.O. Box 1437
Newport, OR 97365

2.4 Test Location: _____

2.5 Laboratory's Personnel to be Assigned to the Study:
Project Manager/Technical Director: _____
Qual. Assurance Officer: _____
Aquatic Biologist: _____
Aquatic Biologist: _____

2.6 Proposed Testing Schedule: Tests to begin within 2 weeks (8 weeks if if held under nitrogen for PSDDA) of sample collection. Reference toxicant test to be run concurrently.

2.7 Good Laboratory Practices:
Tests are conducted according to Good Laboratory Practices (GLP) as

defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are marine sediments. The collected sediments are placed in solvent and acid cleaned 1 L glass jars fitted with TFE-lined screw caps. Samples are stored at 4°C in the dark for up to 14 days. For PSDDA testing, the samples may be stored under nitrogen at 4°C in the dark in the original sealed containers for up to 8 weeks prior to testing. In addition to the test sediments, one or more reference sediments (a clean sediment with physical characteristics similar to the test sediments), must be employed. A second control sediment from a clean site may also be used (optional).

4. TEST WATER

Test water is filtered Yaquina Bay seawater adjusted to a salinity of 28 ppt. The water is pumped daily from Yaquina Bay into a 6000 gal seasoned fiberglass reservoir from which it is supplied under pump pressure to the laboratory. Filtration is accomplished using a sand filter followed by a medium porosity (10-25 um) cartridge filter, then a $\leq$ 0.45 um filter. An alternative seawater supply of similar quality may be used. The use of sterile seawater may be desirable.

5. TEST ORGANISMS

5.1 Species: Pacific oyster, *Crassostrea gigas* or blue mussel, *Mytilus* sp.

5.2 Source: Adult oysters are purchased from Oregon Oyster Co., Newport, OR, a commercial grower. Blue mussels are purchased from a commercial supplier such as Carlsbad Aquafarms, Carlsbad, CA.

5.3 Age at Study Initiation: Less than two-hour-old embryos.

5.4 Conditioning of Adult Oysters: Adult bivalve are conditioned by holding for one to eight weeks in seasoned plastic tubs supplied with 1 L/min of unfiltered Yaquina Bay, OR water (22-32 ppt) at a temperature of 18-20°C (14-18°C for mussels). Supplemental feeding with cultured algae may be desirable. A 14 hour/10 hour light-dark photoperiod is employed.

5.5 Spawning and Fertilization: Adult bivalves are cleaned by brushing and placed into spawning trays supplied with seawater. The bivalves are spawned by gradually increasing the water temperature to 5-10°C above the conditioning temperature over approximately a one hour period. Sperm from a sacrificed male bivalve may be added to the spawning tray to aid stimulation of natural spawning. If spawning does not occur, the water is cooled and the cycle is repeated. Bivalves that begin spawning are isolated in clean sterile seawater for collection of gametes.

Eggs from two or more females are fertilized by addition of sperm from two or more males at a concentration of 10^5 to 10^7/ml. After

fertilization, the embryo density is adjusted to approximately 2000-4000/ml by dilution with 28 ppt seawater. Embryos are kept suspended by frequent gentle agitation with a perforated plunger and the temperature is maintained at test temperature. The quality of the embryos is verified before testing by microscopic examination. Less than 2-hr-old embryos are used in the test.

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are covered 1 L glass beakers. Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or placement in a temperature-controlled environmental chamber. Aeration is generally recommended but not required by PSEP unless dissolved oxygen falls below 60% saturation. Aeration is required for PSDDA. The test is performed under a 14:10 L:D photoperiod with illumination supplied by fluorescent lamps.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027. (NAS SOP No. G-1.) New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%,V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The experimental design consists of exposure of bivalve embryos to a number of test sediments, one or more reference sediments, a clean sand control sediment (optional), and a no-sediment (seawater) control. Each treatment consists of five replicate test containers, each containing from 20,000 to 40,000 bivalve embryos. A sixth replicate series is used for water quality measurements. Complete randomization of test containers is used.

7.2 Test Procedure: Eighteen grams of test or control sediment is added to the appropriate 1 L test container and the test water is added to a final volume of 900 mL. The containers are vigorously mixed for 10 seconds and then allowed to settle for 4 hr. Each test vessel is then inoculated with 20,000 to 40,000 <2-hr-old bivalve embryos (~ 1 ml of embryo stock). The embryos are incubated at 20 ± 1 °C for oysters (16 ± 1°C for mussels) for 48-60 h to permit development into normal prodissoconch I stage larvae. Immediately after inoculation of the test vessels with embryos, 10 ml aliquots are removed from each of the five no-sediment control replicates and preserved in 5% buffered formalin. These are counted at a later date to establish the average initial embryo concentration.

The test is terminated after 48-60 hr by carefully decanting the supernatant liquid into a 1000 ml beaker. Ten milliliter aliquots

are then taken from each beaker and preserved in 5% buffered formalin. The beaker contents are gently agitated using a perforated plastic plunger at the time of aliquot removal to ensure that the aliquots accurately reflect the embryo/larval concentration of the entire test vessel. Larvae are subsequently counted in the 30 mL vials using an inverted compound scope to the determine the total number of larvae and the number failing to develop a complete shell; these data are used for calculating the percent mortality, percent abnormality, and percent combined mortality and abnormality (percent abnormal/dead). Approximately 10% of the samples may be counted by a second investigator as a QA/QC measure.

7.3 Effect Criteria: Effect criteria are: 1) mortality of the embryos, and 2) abnormal development (failure to produce completely developed shells). A third effect expression is a combination of these two, percent abnormal/dead. This is functionally equivalent to percent normal.

The initial number of embryos are determined by averaging the counts of all eggs in initial subsamples of the five seawater control test containers. Live normal larvae are those observed at 48-60 hr in which a fully shelled, straight-hinged, D-shaped prodissoconch I stage has been reached.

7.4 Test Conditions: The test exposure duration is 48-60 h. The test temperature is 20 ± 1°C for oysters and 16 ± 1°C for mussels. The salinity is 28 ± 1 ppt. The photoperiod is a 14:10 hr, L:D cycle of fluorescent light. Aeration is generally recommended but not required for PSEP unless dissolved oxygen falls below 60% saturation; aeration is required for PSDDA (dissolved oxygen must be maintained at ≥ 4 mg/L). Test chambers are 1 L glass beakers held in a controlled temperature environment.

7.5 Feeding: Embryos are not fed during the test.

7.6 Test Duration, Type and Frequency of Observations, and Methods: The test duration is 48-60 hours. The type and frequency of observations to be made during the test are summarized as follows:

Type of Observation	Times of Observation
Biological Data	
Mortality and abnormal development	End of test (at 48-60 hours)
Physical and Chemical Data	
Temperature, dissolved oxygen, salinity, & pH	Daily in water quality beakers
Ammonia-N and sulfide	Beginning & end of test in water quality beakers

Temperature is measured with a calibrated mercury thermometer or telethermometer. Dissolved oxygen is directly measured in test vessels using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. Salinity is measured using a

refractometer. The pH is measured with a pH probe and a calibrated meter with scale divisions of 0.1 pH units. Ammonia-N is measured using the HACH Model FF-3 test kit (ammonia-N detection limit 0.1 mg/L). Sulfide is measured using the HACH Hydrogen Sulfide Test Kit Model HS-WR (sulfide detection limit 0.01 mg/L).

7.7 Criteria of Test Acceptance: The test results are acceptable if at least 70% of the seawater control larvae achieve a normal,D-shaped prodissoconch I stage. Also, for PSDDA, effects in the reference sediments must be ≤35% over the seawater control.

8. DATA ANALYSIS METHODS

Prior to issuance of the July 1995 revision of the PSEP recommended guidelines for conducting laboratory bioassays, no specific guidance was given for the computation of endpoints. All three standard endpoints, percent abnormal, percent combined mortality/abnormality, and percent mortality have occasionally been computed both with, and without, normalization for the seawater control. In order to be consistent with what we assume to be the PSAMP format, all endpoints given in reports are the non-normalized endpoints. In addition, normalized percent mortality (NPM), and normalized combined mortality/abnormality (NCMA) are computed and are included in the raw data computer printouts. The formulas employed for each of these computations are as follows:

PABN (Percent Abnormality) = 100*(A/T)
PABND (Combined Percent Mortality/Abnormality) = 100*((I-N)/I)
PMORT (Percent Mortality) = 100*((I-T)/I)
NPM (Normalized Percent Mortality) = 100*(1-(T/TS))
NCMA (Normalized Combined Percent Mortality/Abnormality) = 100*(1-(N/NS))

where the following are counts per 10 ml subsample:

N = normal larvae counted
A = abnormal larvae counted
T = N+A (total larvae counted)
I = number of inoculated embryos (from average of zero time counts)
TS = average of total larvae counted in seawater controls
NS = average of normal larvae counted in seawater controls

Other endpoints may be computed at client request.

The means and standard deviations are then calculated for each treatment level. Between-treatment comparisons for each biological endpoint may be made using a t-test or a one-way analysis of variance F test (Snedecor and Cochran 1967). An arcsine square root transformation is required for proportional data.

9. REPORTING

A standard NAS report of the test results must include the following information: name and identification of the test; the investigator and laboratory; sediment holding temperature data; information on the test sediment including the interstitial salinity; information on the source of seawater used; detailed information about the test organisms including

acclimation conditions; a description of the experimental design and test chambers and other test conditions including water quality; information about any aeration that may have been required; definition of the effect criteria and other observations; unusual responses, if any, in the control treatment; individual replicate and mean and S.D. data for larval mortality after 48-60 hr; individual replicate and mean and S.D. data for larval abnormalities after 48-60 hr; individual replicate and mean and S.D. data for combined abnormality and mortality; 48-hr LC50 and EC50 with reference toxicant; a description of data analysis methods and documentation of statistical test results; any unusual information about the test or deviations from procedures.

10. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect, and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

11. REFERENCE TOXICANT

Reference toxicant testing should be included with each study or at regular intervals as defined in the Quality Assurance Program of the laboratory.

12. REFERENCED GUIDELINES

ASTM. 1989. Standard guide for conducting static acute toxicity tests with embryos of four species of saltwater bivalve molluscs. ASTM Standard Method No. E 724-89. Am. Soc. Test. Mat., Philadelphia, PA.

PSDDA. 1990. Summary and conclusions of the Puget Sound Dredged Disposal Analysis (PSDDA) Bioassay Workshop, memorandum for the record. U.S. Army Corps of Engineers, Seattle District.

Puget Sound Estuary Program. 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared for U.S. Env. Prot. Agency, Region 10, Office of Puget Sound, Seattle, WA and Puget Sound Water Quality Authority, P.O. Box 40900, Olympia, WA.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods. Sixth ed.. The Iowa State Univ. Press. Ames, Iowa., 593 pp.

Weber, C.I. (Ed.) 1991. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027.

13. APPROVALS

_____ for _____
Name Date

_____ for Northwestern Aquatic Sciences
Name Date

APPENDIX II

RAW DATA

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 590-3 Client Foster Wheeler Investigator

STUDY MANAGEMENT

Client: Foster Wheeler Environmental, 10900 NE 8th St., Suite 1300, Bellevue, WA 98004

Client's Study Monitor: Gary Brown

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Lab

Laboratory's Study Personnel:

Proj. Man./Study Dir. D.S. Caldwell

QA Officer L.K. Memmott

1. G.J. Irisarri 2. B.D. Crane

3. M.C. Redmond 4.

Study Schedule:

Test Beginning: 6/4/98 17:00 Test Ending: 6/6/98 17:00

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	0690F	0691F	0692F	0721F	0722F
Description:	MWAS022R1	MWAS024R1	MWAS025R1	MWAT049R1	MWAT049R1
Collection Date:	5-15-98	5-15-98	5-15-98	5-15-98	5-18-98
Receipt Date:	5-18-98	5-18-98	5-18-98	5-20-98	5-20-98
Inters.Salinity (ppm):	28.5	27.0	28.0	27.0	25.0

NAS Sample No.:	0723F	0727F	0728F	0729F	0730R
Description:	MWAT054R1	MWAT059R1	MWAT053R1	MWAT058R1	MWAT052R1
Collection Date:	5-18-98	5-19-98	5-19-98	5-19-98	5-19-98
Receipt Date:	5-20-98	5-21-98	5-21-98	5-21-98	5-21-98
Inters.Salinity (ppm):	**	25.0	26.0	24.0	24.0

** Insufficient water for salinity measurements

TEST WATER

Source: Manchester, WA

Date of Collection: 6/3/98 Salinity (ppt) 28.0 pH 7.7

Treatments: Filtered to 0.45 µm. aerated

TEST ORGANISMS

Species Mulinia lateralis Date ~~Purchased~~ Collected: 6/4/98

Source: Manchester, WA

Acclimation Data:

Date	Temp (°C)	DO (mg/L)	pH	Sal (ppt)	Comments
Not applicable					
Mean					
S.D.					
(N)					

5/1/91 (Rev. 9-1-94)

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No 590-3 Client Foster Wheeler Investigator

TEST MATERIAL CONTINUATION SHEET

NAS Sample No.:	0749F	0750F	0751F		
Description:	MWRC208R1	MWRC209R1	MWRC210R1		
Collection Date:	5-22-98	5-22-98	5-22-98		
Receipt Date:	5-28-98	5-28-98	5-28-98		
Inters.Salinity (ppm):	28.0	29.0	28.0		

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
Inters.Salinity (ppm):					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
Inters.Salinity (ppm):					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
Inters.Salinity (ppm):					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
Inters.Salinity (ppm):					

NAS Sample No.:					
Description:					
Collection Date:					
Receipt Date:					
Inters.Salinity (ppm):					

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No 590-3 Client Foster Wheeler Investigator _____

SPAWNING AND GAMETE HANDLING

Spawning: Initial 2:00 AM/PM, Final 3:30 AM/PM. Fertilization 4:00 AM/PM

Number of Organisms Used: females 8 ; males 4

Egg Dilution (1 ml diluted to 100 ml):

Count/ml of dilution: 1. 123 ; 2. 112 ; 3. ____ ; Mean 118

DF (mean x 100/3000) = 4.72

TEST PROCEDURES AND CONDITIONS

Test chambers: 1 L glass containers (beakers or bottles)

Test volumes: 100g of test sediment; 1000 ml of test water

Replicates/treatment: (5) 5 Organisms/treatment: (20-40/ml) 32.2

Use: 6th replicate/test sediment for WQ; development assessment beaker.

Test water changes: None Aeration: yes ; Feeding: None

Bottle placement: Total randomization

Larval stock (2,000-4,000/ml) Inoculation volume: 10 ml; <2-hr old

delete the indicated corrections TSL 7/23/98

Subsample size for counting: 10 ml

Photoperiod: 14L:10D

Controls: Negative (clean sediment, no sediment)

Positive (reference toxicant test by ASTM 89 method)

Randomization chart:

1	3	6	9	12	15	18	21	24	27	30
2	2	5	8	11	14	17	20	23	26	29
3	1	4	7	10	13	16	19	22	25	28
4	33	36	39	42	45	48	51	54	57	60
5	32	35	38	41	44	47	50	53	56	59
6	31	34	37	40	43	46	49	52	55	58

Randomization chart:

1	63	66	69	72	75	78	81	84		
2	62	65	68	71	74	77	80	83		
3	61	64	67	70	73	76	79	82		
4										
5										
6										

MISCELLANEOUS NOTES

5/1/91 (Rev. 9-1-94)

Sediment Larvae

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-~~RA4~~

~~MARINE AMPHIPOD~~ 10-DAY SOLID PHASE SEDIMENT TEST

Test No. ~~590-T~~ 590-3 Client FOSTER WHEELER Investigator

SEDIMENT DESCRIPTIONS--SUPLEMENTAL NOTES

Sample No.	Description
0748 F	black sand
0749 F	GRAY/GREEN, FINES AND LIGHT SAND, FEW DEAD WORMS
0750 F	gray/green, fines sand + silt, some dead worms, smell of death
0751 F	dark green, fine silt + sand
0729 F	DARK GRAY GREEN, FINES + SAND.
0690 F	Gray/brown sand, large rocks
0692 F	brown sand + mud some rocks
0691 F	black sand w/ large rocks
0723 F	black sand, few dead worms
0728 F	DARK GRAY/GREEN, FINES & LIGHT SAND
0721 F	dark green/brown fines + rocks, sandy
0727 F	black/gray sand, pieces of wood, bivalves
0730 F	dark brown sandy
0722 F	DARK GRAY/GREEN, SANDY

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 590-3 Client Foster Wheeler Investigator

WATER QUALITY RECORD

Day 0 (6 M 98) BC

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S_{2-} (ppm)	NH3 (ppm)	Comments
1	15.2	5.6	27.0	7.7	<0.01	~~<0.0~~<0.2	
2	15.2	5.5	27.0	7.7	<0.01	<0.2	
4	15.2	5.0	27.0	7.7	<0.01	<0.2	
6	15.2	5.0	27.0	7.7	<0.01	<0.2	
7	15.2	5.0	27.0	7.6	<0.01	<0.2	
14	15.2	7.8	27.0	7.9	<0.01	<0.2	
16	15.2	5.2	27.0	7.7	<0.01	<0.2	
49	15.1	4.8	27.0	7.6	<0.01	<0.2	
55	15.0	5.6	27.0	7.6	<0.01	<0.2	
65	15.0	5.0	27.0	7.7	<0.01	<0.2	
69	15.0	4.8	27.0	7.7	<0.01	0.2	
71	15.0	5.4	27.0	7.7	<0.01	<0.2	
72	15.0	5.4	27.0	7.7	<0.01	<0.2	
82	15.0	5.6	27.0	7.7	<0.01	<0.2	

5/1/91 (Rev. 9-1-94)

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 590-3 Client Foster Wheeler Investigator

WATER QUALITY RECORD

Day 1 (6/5/98) BS

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Comments
1	15.2	7.8	27.0	7.8			
2	15.2	8.0	25.0	7.8			
4	15.1	8.0	25.0	7.9			
6	15.2	7.9	27.0	7.9			
7	15.2	7.9	27.0	7.8			
14	15.2	7.8	27.0	7.9			
16	15.2	7.8	27.0	7.9			
44	15.1	7.6	27.0	7.9			
55	15.1	7.6	27.0	7.8			
65	15.1	7.6	27.0	7.8			
69	15.1	7.6	27.0	7.8			
71	15.0	7.6	27.0	7.9			
72	15.0	7.7	27.0	7.9			
82	15.1	7.6	27.0	7.9			

5/1/91 (Rev. 9-1-94)

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 590-3 Client Foster Wheeler Investigator

WATER QUALITY RECORD

Day 2 (6/6/98) BC

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Comments
1	15.0	8.2	28.0	8.0	<0.01	<0.2	
2	15.0	8.2	28.0	8.0	<0.01	<0.2	
4	15.0	8.2	28.0	8.0	<0.01	<0.2	
6	15.0	8.2	28.0	8.0	<0.01	0.3	
7	15.0	8.2	28.0	7.9	<0.01	<0.2	
14	15.0	8.2	28.0	7.9	<0.01	<0.2	
16	15.0	8.2	28.5	7.9	<0.01	<0.2	
49	15.0	8.0	28.5	7.9	<0.01	<0.2	
55	15.0	7.9	28.0	7.9	<0.01	<0.2	
65	15.0	7.9	28.5	7.9	<0.01	<0.2	
69	15.0	7.9	28.5	7.8	<0.01	<0.2	
71	15.0	7.9	29.0	7.9	<0.01	<0.2	
72	14.9	7.9	29.0	7.9	<0.01	<0.2	
82	14.9	8.0	29.0	7.9	<0.01	<0.2	

5/1/91 (Rev. 9-1-94)

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG4

SEDIMENT LARVAE TEST BASED ON PSEP PROTOCOLS

Test No. 590-3 Client _____ Investigator _____

LARVAL COUNT DATA 7/10/98

Beaker No.	Response N	Response A	Beaker No.	Response N	Response A	Beaker No.	Response N	Response A
1	—	—	49	—	—	97		
2	—	—	50	236	7	98		
3	251	13	51	256	16	99		
4	—	—	52	257	4	100		
5	224	10	53	255	13	101		
6	—	—	54	231	16	102		
7	—	—	55	—	—	103		
8	263	4	56	195	3	104		
9	243	[illegible]	57	247	16	105		
10	260	7	58	207	5	106		
11	202	8	59	161	23	107		
12	241	12	60	242	15	108		
13	256	13	61	249	8	109		
14	—	—	62	225	18	110		
15	256	4	63	244	11	111		
16	—	—	64	246	14	112		
17	241	22	65	—	—	113		
18	264	12	66	214	14	114		
19	271	16	67	272	16	115		
20	213	15	68	251	20	116		
21	245	25	69	—	—	117		
22	255	12	70	245	17	118		
23	255	12	71	—	—	119		
24	230	10	72	—	—	120		
25	261	10	73	208	3	121		
26	219	15	74	218	3	122		
27	209	13	75	223	8	123		
28	253	14	76	242	11	124		
29	246	7	77	197	9	125		
30	205	30	78	234	11	126		
31	255	20	79	242	7	127		
32	199	17	80	174	7	128		
33	251	21	81	262	15	129		
34	246	5	82	—	—	130		
35	250	10	83	227	14	131		
36	255	9	84	227	9	132		
37	219	12	85			133		
38	240	14	86			134		
39	245	17	87	[illegible]		135		
40	224	13	~~88~~ A	[illegible]		136		
41	248	18	~~89~~ B	[illegible]		137		
42	[illegible]	17	~~90~~ C	272		138		
43	218	21	~~91~~ D	[illegible]		139		
44	[illegible]	17	~~92~~ E	[illegible]		140		
45	260	29	93			141		
46	222	12	94			142		
47	256	13	95			143		
48	[illegible]	11	96			144		

5/1/91 (Rev. 9-1-94)

P 590-3 QC COUNT

FOSTER WHEELER 7-21-98

BIVALVES GJI

	BEAKER	N	A
1.	56	189	14
2.	60	238	23
3.	61	242	22
4.	67	263	25
5.	48	207	8
6.	52	257	11
7.	70	237	19
8.	75	221	9
9.	78	224	17
10.	83	222	16

Test number 590-3

Larval Sediment Test
Randomization Key

6/2/98

BKR	NAS SMPL	CLIENT DESCRIP	REPL	
33	swcontrol	swcontrol	1	
67	swcontrol	swcontrol	2	
30	swcontrol	swcontrol	3	
81	swcontrol	swcontrol	4	
70	swcontrol	swcontrol	5	
14	swcontrol	swcontrol	6	wq beaker
45	0690F	MWAS022R1	1	
27	0690F	MWAS022R1	2	
80	0690F	MWAS022R1	3	
66	0690F	MWAS022R1	4	
48	0690F	MWAS022R1	5	
16	0690F	MWAS022R1	6	wq beaker
15	0691F	MWAS024R1	1	
25	0691F	MWAS024R1	2	
42	0691F	MWAS024R1	3	
22	0691F	MWAS024R1	4	
24	0691F	MWAS024R1	5	
4	0691F	MWAS024R1	6	wq beaker
75	0692F	MWAS025R1	1	
74	0692F	MWAS025R1	2	
53	0692F	MWAS025R1	3	
73	0692F	MWAS025R1	4	
9	0692F	MWAS025R1	5	
6	0692F	MWAS025R1	6	wq beaker
11	0721F	MWAT040R1	1	
54	0721F	MWAT040R1	2	
3	0721F	MWAT040R1	3	
39	0721F	MWAT040R1	4	
23	0721F	MWAT040R1	5	
2	0721F	MWAT040R1	6	wq beaker
36	0722F	MWAT049R1	1	
19	0722F	MWAT049R1	2	
83	0722F	MWAT049R1	3	
60	0722F	MWAT049R1	4	
52	0722F	MWAT049R1	5	
72	0722F	MWAT049R1	6	wq beaker
32	0723F	MWAT054R1	1	
21	0723F	MWAT054R1	2	
46	0723F	MWAT054R1	3	
59	0723F	MWAT054R1	4	
50	0723F	MWAT054R1	5	
55	0723F	MWAT054R1	6	wq beaker
35	0727F	MWAT039R1	1	
51	0727F	MWAT039R1	2	
61	0727F	MWAT039R1	3	
10	0727F	MWAT039R1	4	
26	0727F	MWAT039R1	5	
7	0727F	MWAT039R1	6	wq beaker
8	0728F	MWAT043R1	1	
57	0728F	MWAT043R1	2	
43	0728F	MWAT043R1	3	
47	0728F	MWAT043R1	4	

Larval Sediment Test
Randomization Key

BKR	NAS SMPL	CLIENT DESCRIP	REPL	
38	0728F	MWAT043R1	5	
49	0728F	MWAT043R1	6	wq beaker
77	0729F	MWAT048R1	1	
64	0729F	MWAT048R1	2	
62	0729F	MWAT048R1	3	
84	0729F	MWAT048R1	4	
17	0729F	MWAT048R1	5	
82	0729F	MWAT048R1	6	wq beaker
5	0730F	MWAT052R1	1	
18	0730F	MWAT052R1	2	
20	0730F	MWAT052R1	3	
56	0730F	MWAT052R1	4	
29	0730F	MWAT052R1	5	
71	0730F	MWAT052R1	6	wq beaker
28	0749F	MWRC208R1	1	
79	0749F	MWRC208R1	2	
41	0749F	MWRC208R1	3	
63	0749F	MWRC208R1	4	
76	0749F	MWRC208R1	5	
1	0749F	MWRC208R1	6	wq beaker
13	0750F	MWRC209R1	1	
68	0750F	MWRC209R1	2	
78	0750F	MWRC209R1	3	
40	0750F	MWRC209R1	4	
44	0750F	MWRC209R1	5	
69	0750F	MWRC209R1	6	wq beaker
58	0751F	MWRC210R1	1	
31	0751F	MWRC210R1	2	
37	0751F	MWRC210R1	3	
12	0751F	MWRC210R1	4	
34	0751F	MWRC210R1	5	
65	0751F	MWRC210R1	6	wq beaker

Endpoints Data Entry and Calculations File

BKR=beaker number
INIT=number of inoculated embryos (from average of zero-time counts)
NORM=number normal
ABN=number abnormal
TOTAL=NORM+ABN
PMORT=percent mortality=100((INIT-TOTAL)/INIT)
PABN=percent abnormality=100(ABN/TOTAL)
PABND=combined percent mortality and abnormality=100((INIT-NORM)/INIT)
NPM=normalized percent mortality=100(1-(TOTAL/TS)),
where TS=average of total larvae counted in seawater controls
NCMA=normalized combined percent mortality and abnormality=100(1-(NORM/NS)),
where NS=average of normal larvae counted in seawater controls

zero counts	
a	339
b	313
c	292
d	321
e	344
Mean =	322

NS (mean normal)	TS (mean total)
265.6	285.4

%normal in SW cont relative to INIT
82.5

Data entry verified against laboratory bench sheets — MSR 7-30-98

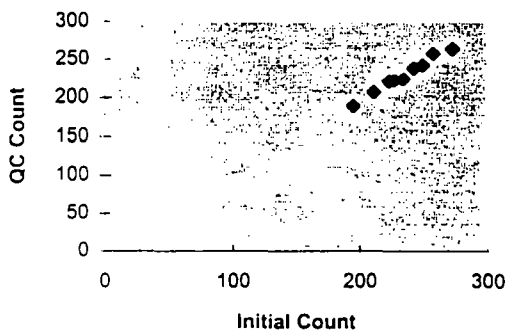
INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REP	INIT	NORM	ABN	TOTAL	PMORT	PABN	PABND	NPM	NCMA		PMORT	PABN	PABND	NPM	NCMA
1	33	swcontrol	swcontrol	1	322	251	21	272	15.5	7.7	22.0	4.7	5.5						
2	67	swcontrol	swcontrol	2	322	272	16	288	10.5	5.6	15.5	-0.9	-2.4	Mean	11.3	6.9	17.5	0.0	0.0
3	30	swcontrol	swcontrol	3	322	295	30	325	-1.0	9.2	8.3	-13.9	-11.1	S.D.	7.7	1.6	6.4	8.7	7.7
4	81	swcontrol	swcontrol	4	322	268	15	283	12.1	5.3	16.7	0.8	-0.9	n	5	5	5	5	5
5	70	swcontrol	swcontrol	5	322	242	17	259	19.5	6.6	24.8	9.3	8.9						
6	14	swcontrol	swcontrol	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
7	45	0690F	MWAS022R1	1	322	260	29	289	10.2	10.0	19.2	-1.3	2.1						
8	27	0690F	MWAS022R1	2	322	209	13	222	31.0	5.9	35.1	22.2	21.3	Mean	29.0	6.2	33.6	20.0	19.6
9	80	0690F	MWAS022R1	3	322	174	7	181	43.8	3.9	45.9	36.6	34.5	S.D.	12.0	2.3	9.5	13.6	11.5
10	66	0690F	MWAS022R1	4	322	214	14	228	29.1	6.1	33.5	20.1	19.4	n	5	5	5	5	5
11	48	0690F	MWAS022R1	5	322	211	11	222	31.0	5.0	34.4	22.2	20.6						
12	16	0690F	MWAS022R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
13	15	0691F	MWAS024R1	1	322	232	4	236	26.7	1.7	27.9	17.3	12.7						

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REP	INIT	NORM	ABN	TOTAL	PMORT	PABN	PABND	NPM	NCMA		PMORT	PABN	PABND	NPM	NCMA
14	25	0691F	MWAS024R1	2	322	261	10	271	15.8	3.7	18.9	5.0	1.7	Mean	18.5	4.0	21.8	8.1	5.3
15	42	0691F	MWAS024R1	3	322	280	17	297	7.7	5.7	13.0	-4.1	-5.4	S.D.	7.8	1.5	6.5	8.7	7.9
16	22	0691F	MWAS024R1	4	322	255	12	267	17.0	4.5	20.8	6.4	4.0	n	5	5	5	5	5
17	24	0691F	MWAS024R1	5	322	230	10	240	25.4	4.2	28.5	15.9	13.4						
18	4	0691F	MWAS024R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
19	75	0692F	MWAS025R1	1	322	223	8	231	28.2	3.5	30.7	19.1	16.0						
20	74	0692F	MWAS025R1	2	322	218	3	221	31.3	1.4	32.3	22.6	17.9	Mean	25.5	2.6	27.5	16.0	12.1
21	53	0692F	MWAS025R1	3	322	255	13	268	16.7	4.9	20.8	6.1	4.0	S.D.	8.3	1.5	7.5	9.4	9.1
22	73	0692F	MWAS025R1	4	322	208	3	211	34.4	1.4	35.4	26.1	21.7	n	5	5	5	5	5
23	9	0692F	MWAS025R1	5	322	263	5	268	16.7	1.9	18.3	6.1	1.0						
24	6	0692F	MWAS025R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
25	11	0721F	MWAT040R1	1	322	202	8	210	34.7	3.8	37.2	26.4	23.9						
26	54	0721F	MWAT040R1	2	322	231	16	247	23.2	6.5	28.2	13.5	13.0	Mean	22.3	5.2	26.4	12.4	10.8
27	3	0721F	MWAT040R1	3	322	251	13	264	18.0	4.9	22.0	7.5	5.5	S.D.	7.4	1.2	6.7	8.3	8.1
28	39	0721F	MWAT040R1	4	322	245	17	262	18.6	6.5	23.9	8.2	7.8	n	5	5	5	5	5
29	23	0721F	MWAT040R1	5	322	255	12	267	17.0	4.5	20.8	6.4	4.0						
30	2	0721F	MWAT040R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
31	36	0722F	MWAT049R1	1	322	255	9	264	18.0	3.4	20.8	7.5	4.0						
32	19	0722F	MWAT049R1	2	322	271	16	287	10.8	5.6	15.8	-0.6	-2.0	Mean	18.5	4.6	22.2	8.1	5.7
33	83	0722F	MWAT049R1	3	322	227	16	243	24.5	6.6	29.5	14.9	14.5	S.D.	5.0	2.1	5.2	5.6	6.3
34	60	0722F	MWAT049R1	4	322	242	15	257	20.1	5.8	24.8	10.0	8.9	n	5	5	5	5	5
35	52	0722F	MWAT049R1	5	322	257	4	261	18.9	1.5	20.1	8.5	3.2						
36	72	0722F	MWAT049R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
37	32	0723F	MWAT054R1	1	322	199	17	216	32.9	7.9	38.2	24.3	25.1						
38	21	0723F	MWAT054R1	2	322	245	25	270	16.1	9.3	23.9	5.4	7.8	Mean	26.8	7.2	32.1	17.5	17.7
39	46	0723F	MWAT054R1	3	322	222	12	234	27.3	5.1	31.0	18.0	16.4	S.D.	7.1	3.2	7.2	8.0	8.7
40	59	0723F	MWAT054R1	4	322	191	23	214	33.5	10.7	40.6	25.0	28.1	n	5	5	5	5	5
41	50	0723F	MWAT054R1	5	322	236	7	243	24.5	2.9	26.7	14.9	11.1						
42	55	0723F	MWAT054R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
43	35	0727F	MWAT039R1	1	322	250	10	260	19.2	3.8	22.3	8.9	5.9						
44	51	0727F	MWAT039R1	2	322	256	16	272	15.5	5.9	20.4	4.7	3.6	Mean	19.8	4.4	23.3	9.6	7.1
45	61	0727F	MWAT039R1	3	322	249	8	257	20.1	3.1	22.6	10.0	6.3	S.D.	4.6	1.7	5.0	5.1	6.1
46	10	0727F	MWAT039R1	4	322	260	7	267	17.0	2.6	19.2	6.4	2.1	n	5	5	5	5	5
47	26	0727F	MWAT039R1	5	322	219	15	234	27.3	6.4	31.9	18.0	17.5						
48	7	0727F	MWAT039R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
49	8	0728F	MWAT043R1	1	322	263	4	267	17.0	1.5	18.3	6.4	1.0						

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REP	INIT	NORM	ABN	TOTAL	PMORT	PABN	PABND	NPM	NCMA		PMORT	PABN	PABND	NPM	NCMA
50	57	0728F	MWAT043R1	2	322	249	16	265	17.7	6.0	22.6	7.1	6.3	Mean	18.3	5.2	22.6	7.9	6.2
51	43	0728F	MWAT043R1	3	322	258	21	279	13.3	7.5	19.8	2.2	2.9	S.D.	3.7	2.2	3.6	4.1	4.3
52	47	0728F	MWAT043R1	4	322	236	13	249	22.6	5.2	26.7	12.8	11.1	n	5	5	5	5	5
53	38	0728F	MWAT043R1	5	322	240	14	254	21.1	5.5	25.4	11.0	9.6						
54	49	0728F	MWAT043R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
55	77	0729F	MWAT048R1	1	322	197	9	206	36.0	4.4	38.8	27.8	25.8						
56	64	0729F	MWAT048R1	2	322	246	14	260	19.2	5.4	23.6	8.9	7.4	Mean	25.0	6.0	29.5	15.4	14.6
57	62	0729F	MWAT048R1	3	322	225	19	244	24.2	7.8	30.1	14.5	15.3	S.D.	7.2	2.0	5.9	8.1	7.2
58	84	0729F	MWAT048R1	4	322	225	9	234	27.3	3.8	30.1	18.0	15.3	n	5	5	5	5	5
59	17	0729F	MWAT048R1	5	322	241	22	263	18.3	8.4	25.1	7.8	9.3						
60	82	0729F	MWAT048R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
61	5	0730F	MWAT052R1	1	322	224	10	234	27.3	4.3	30.4	18.0	15.7						
62	18	0730F	MWAT052R1	2	322	264	12	276	14.2	4.3	18.0	3.3	0.6	Mean	26.1	3.9	29.0	16.7	14.0
63	20	0730F	MWAT052R1	3	322	213	15	228	29.1	6.6	33.8	20.1	19.8	S.D.	9.0	1.9	8.4	10.2	10.2
64	56	0730F	MWAT052R1	4	322	195	3	198	38.5	1.5	39.4	30.6	26.6	n	5	5	5	5	5
65	29	0730F	MWAT052R1	5	322	246	7	253	21.4	2.8	23.6	11.4	7.4						
66	71	0730F	MWAT052R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
67	28	0749F	MWRC208R1	1	322	253	14	267	17.0	5.2	21.4	6.4	4.7						
68	79	0749F	MWRC208R1	2	322	242	7	249	22.6	2.8	24.8	12.8	8.9	Mean	19.8	4.7	23.6	9.6	7.5
69	41	0749F	MWRC208R1	3	322	248	18	266	17.3	6.8	22.9	6.8	6.6	S.D.	2.5	1.4	1.5	2.8	1.8
70	63	0749F	MWRC208R1	4	322	244	11	255	20.8	4.3	24.2	10.7	8.1	n	5	5	5	5	5
71	76	0749F	MWRC208R1	5	322	242	11	253	21.4	4.3	24.8	11.4	8.9						
72	1	0749F	MWRC208R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
73	13	0750F	MWRC209R1	1	322	256	13	269	16.4	4.8	20.4	5.7	3.6						
74	68	0750F	MWRC209R1	2	322	251	20	271	15.8	7.4	22.0	5.0	5.5	Mean	19.8	5.8	24.4	9.5	8.4
75	78	0750F	MWRC209R1	3	322	234	11	245	23.9	4.5	27.3	14.2	11.9	S.D.	5.0	1.2	4.2	5.6	5.1
76	40	0750F	MWRC209R1	4	322	224	13	237	26.4	5.5	30.4	17.0	15.7	n	5	5	5	5	5
77	44	0750F	MWRC209R1	5	322	251	18	269	16.4	6.7	22.0	5.7	5.5						
78	69	0750F	MWRC209R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						
79	58	0751F	MWRC210R1	1	322	207	5	212	34.1	2.4	35.7	25.7	22.1						
80	31	0751F	MWRC210R1	2	322	255	20	275	14.5	7.3	20.8	3.6	4.0	Mean	23.6	5.1	27.5	13.8	12.2
81	37	0751F	MWRC210R1	3	322	219	12	231	28.2	5.2	31.9	19.1	17.5	S.D.	7.7	1.8	6.1	8.7	7.4
82	12	0751F	MWRC210R1	4	322	241	12	253	21.4	4.7	25.1	11.4	9.3	n	5	5	5	5	5
83	34	0751F	MWRC210R1	5	322	244	15	259	19.5	5.8	24.2	9.3	8.1						
84	65	0751F	MWRC210R1	6	322			0	100.0	#DIV/0!	100.0	100.0	100.0						

Comparison of Initial Counts and QC Counts

Beaker	Normal Larvae				
	Initial Count		QC Count		
No.	Normal	Abnormal	Normal	Abnormal	cv(normal)
48	211	11	207	8	1
52	257	4	257	11	0
56	195	3	189	14	2
60	242	15	238	23	1
61	249	8	242	22	2
67	272	16	263	25	2
70	242	17	237	19	1
75	223	8	221	9	1
78	234	11	224	17	3
83	227	16	222	16	2



Intercept	-1.38
Slope	0.983758
r square	0.981996

Data entry verified against laboratory bench sheets
JWR 7-22-98

Water Quality Data File

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	PH	S	NH3
1	0749F	MWRC208R1	6	0	15.2	5.6	27.0	7.7	<0.01	<0.2
2	0721F	MWAT040R1	6	0	15.2	5.5	27.0	7.7	<0.01	<0.2
4	0691F	MWAS024R1	6	0	15.2	5.0	27.0	7.7	<0.01	<0.2
6	0692F	MWAS025R1	6	0	15.2	5.0	27.0	7.7	<0.01	<0.2
7	0727F	MWAT039R1	6	0	15.2	5.0	27.0	7.6	<0.01	<0.2
14	swcontrol	swcontrol	6	0	15.2	7.8	27.0	7.9	<0.01	<0.2
16	0690F	MWAS022R1	6	0	15.2	5.2	27.0	7.7	<0.01	<0.2
49	0728F	MWAT043R1	6	0	15.1	4.8	27.0	7.6	<0.01	<0.2
55	0723F	MWAT054R1	6	0	15.0	5.6	27.0	7.6	<0.01	<0.2
65	0751F	MWRC210R1	6	0	15.0	5.0	27.0	7.7	<0.01	<0.2
69	0750F	MWRC209R1	6	0	15.0	4.8	27.0	7.7	<0.01	0.2
71	0730F	MWAT052R1	6	0	15.0	5.4	27.0	7.7	<0.01	<0.2
72	0722F	MWAT049R1	6	0	15.0	5.4	27.0	7.7	<0.01	<0.2
82	0729F	MWAT048R1	6	0	15.0	5.6	27.0	7.7	<0.01	<0.2
1	0749F	MWRC208R1	6	1	15.2	7.8	28.0	7.8		
2	0721F	MWAT040R1	6	1	15.2	8.0	28.0	7.8		
4	0691F	MWAS024R1	6	1	15.1	8.0	28.0	7.9		
6	0692F	MWAS025R1	6	1	15.2	7.9	27.0	7.9		
7	0727F	MWAT039R1	6	1	15.2	7.9	27.0	7.8		
14	swcontrol	swcontrol	6	1	15.2	7.8	27.0	7.9		
16	0690F	MWAS022R1	6	1	15.2	7.8	27.0	7.9		
49	0728F	MWAT043R1	6	1	15.1	7.6	27.0	7.9		
55	0723F	MWAT054R1	6	1	15.1	7.6	27.0	7.8		
65	0751F	MWRC210R1	6	1	15.1	7.6	28.0	7.8		
69	0750F	MWRC209R1	6	1	15.1	7.6	28.0	7.8		
71	0730F	MWAT052R1	6	1	15.0	7.6	28.0	7.9		
72	0722F	MWAT049R1	6	1	15.0	7.7	28.0	7.9		
82	0729F	MWAT048R1	6	1	15.1	7.6	28.0	7.9		
1	0749F	MWRC208R1	6	2	15.0	8.2	28.0	8.0	<0.01	<0.2
2	0721F	MWAT040R1	6	2	15.0	8.2	28.0	8.0	<0.01	<0.2
4	0691F	MWAS024R1	6	2	15.0	8.2	28.0	8.0	<0.01	<0.2
6	0692F	MWAS025R1	6	2	15.0	8.2	28.0	8.0	<0.01	0.3
7	0727F	MWAT039R1	6	2	15.0	8.2	28.0	7.9	<0.01	<0.2
14	swcontrol	swcontrol	6	2	15.0	8.2	28.0	7.9	<0.01	<0.2
16	0690F	MWAS022R1	6	2	15.0	8.2	28.5	7.9	<0.01	<0.2
49	0728F	MWAT043R1	6	2	15.0	8.0	28.5	7.9	<0.01	<0.2
55	0723F	MWAT054R1	6	2	15.0	7.9	28.0	7.9	<0.01	<0.2
65	0751F	MWRC210R1	6	2	15.0	7.9	28.5	7.9	<0.01	<0.2
69	0750F	MWRC209R1	6	2	15.0	7.9	28.5	7.8	<0.01	<0.2
71	0730F	MWAT052R1	6	2	15.0	7.9	29.0	7.9	<0.01	<0.2
72	0722F	MWAT049R1	6	2	14.9	7.9	29.0	7.9	<0.01	<0.2
82	0729F	MWAT048R1	6	2	14.9	8.0	29.0	7.9	<0.01	<0.2

	TEMP	DO	SAL	PH	S	NH3
Mean	15.1	7.1	27.6	7.8		
SD	0.1	1.3	0.7	0.1		
n	42	42	42	42	28	28
Max	15.2	8.2	29.0	8.0	<0.01	0.3
Min	14.9	4.8	27.0	7.6	<0.01	<0.2

Data entry verified against laboratory data sheets MLR 7-22-98

Page 1 of 1 Lab Ref No

Chain of Custody Record

FOSTER WHEELER ENVIRONMENTAL CORPORATION
10900 NE 8th Street • Bellevue, WA 98004
(206) 688-3700 • Fax (206) 688-3952

~~Alaska Pulp Corporation~~
~~Bay OU RI/FS Studies~~
~~Sitka, Alaska~~ Middle Waterway
FW Project No: ~~1447.9000.2000~~ 1697.0010.00016

Sampling Date: 5/15/98
Shipping Date: 5/16/98
Shipping Ref.:

Analytical Laboratory: ~~Columbia Analytical Services (360 577 7222)~~ Nw Aquatic
Laboratory Contact: ~~Abbie Spielman~~ P.O. No.:
Reports to be Sent to: ~~Brenda Steele (FW)~~ Kata Ritenburg
Address/Phone No.: ~~206 688-3849~~ 425-688-3700

Sampler(s) (printed name): Carol Hurley
Sampler(s) (signature): Carol Hurley
Special Instructions:

SAMPLE IDENTIFICATION	TIME COLLECTED	NO OF CONTAINERS, SIZE & TYPE	PRESERVATIVE	MATRIX	SAMPLE TYPE Composite	SAMPLE TYPE Grab	Dioxins/Furans 8290	Metals PSEP 6010/7000/200.8 (As,Ba,Cd,Cr,Pb,Se,Ag,Cu,Mn,Ni,Zn)	Sediment Conventionals PSEP Methods (Total Solids,Total Sulfides,Acid Volatiles Sulfides,TOC, Ammonia as Nitrogen,Grain Size,BOD,COD)	Guaiacols EPA 1653	Resin Acids, Fatty Acids, Bleach Plant Derivatives NCASI RA/FA-85.01 mod.	Lipids	REMARKS
MWAS024R1	11:00	6 - 32 oz	None	Sed	X								✓ NAR# 0691F
MWAS025R1	14:37	6 - 32 oz	None	Sed	X								✓ 0692F
MWAS022R1	16:10	6 - 32 oz	None	Sed	X								✓ 0690F

Bioassays Suite in Contract for MW Project
Amphipod + Echinoderm
Hold for possible Neanthes

Turnaround Time: [ ] Standard [ ] 1 Week [ ] 4 Work Day [ ] 3 Work Day [ ] 2 Work Day [ ] 24 Hour

Sample Receipt: Total # Containers Rec'd 18; COC Seals Present? no; COC Seals Intact?; Received Cold? yes; Received Intact? yes; Received Via FedEx

Relinquished by: (signature) Carol Hurley Date 5/15/98 Time 22:05
Received by: (signature) [illegible] Date 5/18/98 Time 15:00

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

-17-

MultiChem
ANALYTICAL SERVICES

560 Naches Ave. SW Suite 101 Renton, WA 98055
(800) 609-0580 • (425) 228-8335 • FAX (425) 228-8336

LAB NUMBER: [illegible]
DATE: 5/18/98
PAGE: 1 of 1

COMPANY: Foster Wheeler Envr
ADDRESS: 10900 NE 8th St Ste 1300
Bellevue, WA

PHONE: (425) 688 3700 FAX (425) 688 3952
PROJ. MGR / CONTACT: Kate Rutenberg
PROJECT NUMBER: 1699.0010.0006
PROJECT NAME:
DISPOSAL: ☐ MAS ☑ HOLD ☐ RETURN

FUELS | ORGANIC COMPOUNDS | METALS | TCLP | OTHER

Bioassay per Contract

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	
MWAT0518K1 5-32 oz	5/18/98	11:50	Soil	0723	F
MWAT0419K1 5-32 oz	5/18/98	13:50	Soil	0722	F
MWAT0410K1 5-32 oz	5/18/98	17:30	Soil	0721	F

SAMPLE RECEIPT			TAT:
TOTAL # OF CONTAINERS?	☑ YES	☐ NO	☐ 24 HOURS
COC SEALS PRESENT?	☐ YES	☒ NO	☐ 48 HOURS
COC SEALS INTACT?	☐ YES	☐ NO	☐ 72 HOURS
RECEIVED COLD?	☒ YES	☐ NO	☐ 7 DAYS
RECEIVED INTACT?	☒ YES	☐ NO	☐ [illegible]
RECEIVED VIA:	Fed Ex		☐ [illegible]

Unpreserved Jarred → Hold Soil for possible Dioxins

*METALS NEEDED

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
SIGNATURE: Carol Hutley	SIGNATURE:	SIGNATURE:
PRINT NAME: CAROL HUTLEY	PRINT NAME:	PRINT NAME:
DATE: 5/19/98 TIME: 11:40	DATE: TIME:	DATE: TIME:
COMPANY:	COMPANY:	COMPANY:
RECEIVED BY:	RECEIVED BY:	RECEIVED BY:
SIGNATURE: [illegible] Caldwell	SIGNATURE:	SIGNATURE:
PRINT NAME: Richard S. Caldwell	PRINT NAME:	PRINT NAME:
DATE: 5/20/98 TIME: 15:20	DATE: TIME:	DATE: TIME:
COMPANY: MW Analytic	COMPANY:	COMPANY:

MAS USE ONLY: SUBCONTRACT LAB: PO #:

MultiChem ANALYTICAL SERVICES

560 Naches Ave. SW Suite 101 Renton, WA 98055
(800) 609 0580 • (425) 228-8335 • FAX (425) 228-8336

LAB NUMBER: [illegible]

DATE: 5/19/98
PAGE: 1 of 1

COMPANY: Foster Wheeler Enviro
ADDRESS: 10900 NE 8th St Ste 1300
Bellevue, WA

PHONE: (425) 688 3100 FAX (425) 688 3952
PROJ MGR / CONTACT: Kate Pilenberg
PROJECT NUMBER: 1699.0010.02.06
PROJECT NAME: Middle Waterway
DISPOSAL: ☐ MAS ☐ HOLD ☐ RETURN

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	Bioassay per Contract
MWAT03R1				0727F	
5-32 oz	5/19/98	15:40	Sed	0727F	X
MWAT04R1				0729F	
5-32 oz	5/19/98	16:50	Sed	0729F	X
MWAT03R1				0728F	
5-32 oz	5/19/98	18:20	Sed	0728F	X
MWAT05R1				0730F	
5-32 oz	5/19/98	18:50	Sed	0730F	X

SAMPLE RECEIPT			TAT	
TOTAL # OF CONTAINERS	☐ YES	☐ NO	☐ 24 HOURS	
COC SEALS PRESENT?	☐ YES	☐ NO	☐ 48 HOURS	
COC SEALS INTACT?	☐ YES	☐ NO	☐ 72 HOURS	
RECEIVED COLD?	☐ YES	☐ NO	☐ 7 DAYS	
RECEIVED INTACT?	☐ YES	☐ NO	☐ SP	
RECEIVED VIA:			☐ STANDARD	

SPECIAL INSTRUCTIONS/COMMENTS:
Amphipod & larval bioassay per contract
Hold sediment for potential recollection
Collection time on jar for MWAT03R1 is 15:40 or 3:40 PM
Jar #3 for MWAT04R1 was broken
Jar #3 of MWAT02R1 was broken
5-21-98
METALS NEEDED: Collect Times CFSB
MWAT02R1 is 18:50 or 6:50 PM

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
SIGNATURE: Carol Hedley	SIGNATURE:	SIGNATURE:
PRINT NAME: CAROL HEDLEY	PRINT NAME:	PRINT NAME:
DATE: 5/19/98 TIME: 8:05AM	DATE: TIME:	DATE: TIME:
COMPANY:	COMPANY:	COMPANY:
RECEIVED BY:	RECEIVED BY:	RECEIVED BY:
SIGNATURE: [illegible]	SIGNATURE:	SIGNATURE:
PRINT NAME: Greg A. Bahr	PRINT NAME:	PRINT NAME:
DATE: 5/21/98 TIME: 1500	DATE: TIME:	DATE: TIME:
COMPANY: Northwest Aquatic	COMPANY:	COMPANY:

MAS USE ONLY: SUBCONTRACT LAB: PO #:

Chain of Custody Record
Request for Analysis

Page 1 of 1 Lab. Ref. No.

FOSTER WHEELER ENVIRONMENTAL CORPORATION
10900 NE 8th Street • Bellevue, WA 98004
(206) 688-3700 • Fax (206) 688-3952

Project Name: Middle WATERWAY
Project Address: 10900 NE 8th St. Bellevue, WA 98004
FW Project No: 1699.0010.0005

Sampling Date: 5-22-98
Shipping Date:
Shipping Ref:

Hazard ID:
- [X] Nonhazardous
- [ ] Hazardous:
  - [ ] Reactive
  - [ ] Toxic
  - [ ] Flammable
  - [ ] Irritant
  - [ ] Infectious
  - [ ] Radioactive

Sample Disposal Instructions:
- [X] Lab disposal
- [ ] Return to FWENC
- [ ] Hold for pickup (will call)

Analysis Laboratory: Northwestern Aquatic Sciences
Laboratory Contact: Dick Caldwell P.O. No.:
Reports to be Sent to: Gary Braun
Address/Phone No.: 425-688-3700 Fax 425-688-3951

Sampler(s) (printed name): D. Brent Jones
Sampler(s) (signature): D. Brent Jones
Special Instructions:

ANALYSES REQUEST (circle appropriate method number)

SAMPLE IDENTIFICATION	TIME COLLECTED	NO OF CONTAINERS SIZE & TYPE	PRESERVATIVE	MATRIX	SAMPLE TYPE Composite	SAMPLE TYPE Grab	Method Standard	TCLP (1311)	CLP Data Pkg.: Other	Halogenated Volatiles 8010, 601, 502.1, CLP	Aromatic Volatiles 8020, 602, 502.2, 503.1, CLP	BETX Only 8020, 602, CLP	GC/MS Vol. 8240, 8260, 624, 524.1, 524.2, CLP	GC/MS BNA (semi-vol.) 8250, 8270, 625, 525, CLP	Pesticides & PCBs 8080, 8081, 608, 505, 508, CLP	PCBs Only 8080, 608, 508A, CLP	HPLC PNA/PAHs 8310, 610	Ordnance/Explosives HPLC 8330 mod. GC/ECD	TPH-HCID AK, OR, WA, 416.1	TPH-G AK, OR, WA, 8015 mod	TPH-D AK, OR, WA, 8015 mod	Lead 6010, 7420, 7421	Priority Poll. Metals (13) 6010 & 7000 Series CLP	TCL Metals (23) 6010 & 7000 Series, CLP	TCLP 1311 (metals, VOAs, SVOAs, Pest., Herb.)	BIOASSAY (as per Contract)	REMARKS
~~208RC~~ DBJ	1445	(6) 8oz glass																									
MWRC208RI DBJ	~~1530~~	↓	none	SEDIMENT	X			NAC	#			0749F													X		cool to 4°C
MWRC209RJ	1530		↓	↓	↓							0750F													X		↓
MWRC210RI	1600											0751F													X		

Turnaround Time	Sample Receipt	Relinquished by (signature)	Relinquished by: (signature)	Relinquished by: (signature)	Relinquished by: (signature)
[X] Standard	Total # Containers Recvd	D. Brent Jones			
[ ] 1 Week	COC Seals Present?	Date 5/22/98 Time	Date Time	Date: Time:	Date: Time:
[ ] 72 Hours	COC Seals Intact?	Received by (signature)	Received by: (signature)	Received by: (signature)	Received by: (signature)
[ ] 48 Hours	Received Cold?	David Williams			
[ ] 24 Hours	Received Intact?	Date 5-28-98 Time 10:30	Date Time:	Date: Time:	Date: Time:
[ ] Other	Received Via				

ADM409—10/96

Larval Sediment Test-Proportional Mortality

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.1703	0.2262	0.1734	0.2076	0.2138
MWRC209R1	0.1641	0.1579	0.2387	0.2635	0.1641
MWAS022R1	0.1019	0.3101	0.4375	0.2915	0.3101
MWAS024R1	0.2666	0.1579	0.0771	0.1703	0.2542
MWAS025R1	0.2822	0.3132	0.1672	0.3443	0.1672
MWAT040R1	0.3474	0.2324	0.1796	0.1858	0.1703
MWAT049R1	0.1796	0.1081	0.2449	0.2014	0.1889
MWAT054R1	0.3288	0.1610	0.2728	0.3350	0.2449
MWAT039R1	0.1920	0.1548	0.2014	0.1703	0.2728
MWAT043R1	0.1703	0.1765	0.1330	0.2262	0.2107
MWAT048R1	0.3599	0.1920	0.2418	0.2728	0.1827
MWAT052R1	0.2728	0.1423	0.2915	0.3847	0.2138
swcontrol	0.1548	0.1050	0.0000	0.1206	0.1952
MWRC210R1	0.3412	0.1454	0.2822	0.2138	0.1952

Comparison to MWRC208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.1983	1.0031	0.4609	0.4254	0.4957	6.859	5		for $\alpha = 0.10$ is 1.397 MWR 7-28-98	
MWRC209R1	0.1976	1.0000	0.4584	0.4086	0.5391	13.408	5			
*MWAS022R1	0.2902	1.4686	0.5599	0.3249	0.7228	25.842	5	1.495	~~1.860~~	0.0082
MWAS024R1	0.1852	0.9371	0.4373	0.2813	0.5426	24.174	5	-0.478	~~1.860~~	0.0045
MWAS025R1	0.2548	1.2893	0.5247	0.4212	0.6271	18.562	5	1.394	~~1.860~~	0.0039
MWAT040R1	0.2231	1.1289	0.4884	0.4254	0.6303	17.353	5	0.681	~~1.860~~	0.0030
MWAT049R1	0.1846	0.9340	0.4411	0.3351	0.5177	15.113	5	-0.599	~~1.860~~	0.0020
* MWAT054R1	0.2685	1.3585	0.5416	0.4128	0.6172	15.366	5	2.028	~~1.860~~	0.0029
MWAT039R1	0.1983	1.0031	0.4597	0.4043	0.5496	12.111	5	-0.042	~~1.860~~	0.0015
MWAT043R1	0.1833	0.9277	0.4410	0.3733	0.4957	10.852	5	-0.776	~~1.860~~	0.0012
*MWAT048R1	0.2498	1.2642	0.5205	0.4417	0.6433	15.687	5	1.522	~~1.860~~	0.0029
*MWAT052R1	0.2610	1.3208	0.5313	0.3868	0.6691	19.800	5	1.434	~~1.860~~	0.0045
swcontrol	0.1151	0.5824	0.3149	0.0279	0.4576	53.268	5	-1.912	~~1.860~~	0.0108
MWRC210R1	0.2356	1.1918	0.5027	0.3913	0.6238	18.040	5	0.973	~~1.860~~	0.0034

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.53946	1.035	-0.7242	1.28598
Bartlett's Test indicates equal variances (p = 0.23)	15.2456	26.217		
The control means are not significantly different (p = 0.94)	0.07852	2.30601		

Hypothesis Test (1-tail, ~~0.05~~ MWR 7-25-98

Homoscedastic t Test indicates significant differences

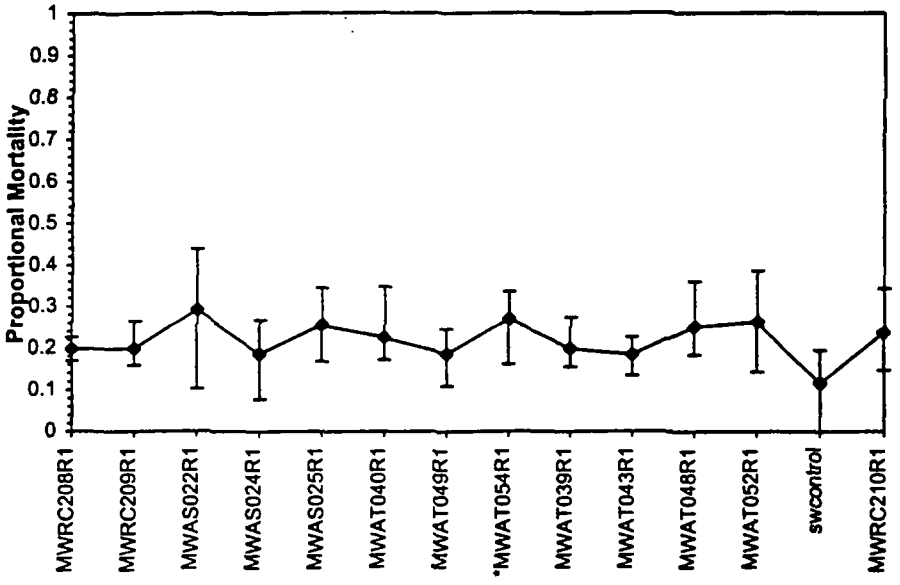
* significantly different from reference MWRC208R1 at $p \leq 0.10$

ToxCalc v5.0.15N

Larval Sediment Test-Proportional Mortality

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		*Protocol:*	*PSEP 1995-Puget Sound*	*Test Species:*	*MG-Mytilus galloprovincialis*
Comments:					

Dose-Response Plot



Larval Sediment Test-Proportional Mortality

Start Date:	6/4/98	Test ID:	590-3	~~Sample ID:~~	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.1703	0.2262	0.1734	0.2076	0.2138
MWRC209R1	0.1641	0.1579	0.2387	0.2635	0.1641
MWAS022R1	0.1019	0.3101	0.4375	0.2915	0.3101
MWAS024R1	0.2666	0.1579	0.0771	0.1703	0.2542
MWAS025R1	0.2822	0.3132	0.1672	0.3443	0.1672
MWAT040R1	0.3474	0.2324	0.1796	0.1858	0.1703
MWAT049R1	0.1796	0.1081	0.2449	0.2014	0.1889
MWAT054R1	0.3288	0.1610	0.2728	0.3350	0.2449
MWAT039R1	0.1920	0.1548	0.2014	0.1703	0.2728
MWAT043R1	0.1703	0.1765	0.1330	0.2262	0.2107
MWAT048R1	0.3599	0.1920	0.2418	0.2728	0.1827
MWAT052R1	0.2728	0.1423	0.2915	0.3847	0.2138
swcontrol	0.1548	0.1050	0.0000	0.1206	0.1952
MWRC210R1	0.3412	0.1454	0.2822	0.2138	0.1952

Comparison to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.1983	1.0031	0.4609	0.4254	0.4957	6.859	5		for α=0.10 MLR 7-28-98	
MWRC209R1	0.1976	1.0000	0.4584	0.4086	0.5391	13.408	5		is 1.397	
*MWAS022R1	0.2902	1.4686	0.5599	0.3249	0.7228	25.842	5	1.443	~~1.860~~	0.0092
MWAS024R1	0.1852	0.9371	0.4373	0.2813	0.5426	24.174	5	-0.387	~~1.860~~	0.0056
MWAS025R1	0.2548	1.2893	0.5247	0.4212	0.6271	18.562	5	1.287	~~1.860~~	0.0049
MWAT040R1	0.2231	1.1289	0.4884	0.4254	0.6303	17.353	5	0.641	~~1.860~~	0.0041
MWAT049R1	0.1846	0.9340	0.4411	0.3351	0.5177	15.113	5	-0.428	~~1.860~~	0.0031
*MWAT054R1	0.2685	1.3585	0.5416	0.4128	0.6172	15.366	5	1.797	~~1.860~~	0.0040
MWAT039R1	0.1983	1.0031	0.4597	0.4043	0.5496	12.111	5	0.033	~~1.860~~	0.0026
MWAT043R1	0.1833	0.9277	0.4410	0.3733	0.4957	10.852	5	-0.501	~~1.860~~	0.0023
MWAT048R1	0.2498	1.2642	0.5205	0.4417	0.6433	15.687	5	1.357	~~1.860~~	0.0039
MWAT052R1	0.2610	1.3208	0.5313	0.3868	0.6691	19.800	5	1.337	~~1.860~~	0.0055
swcontrol	0.1151	0.5824	0.3149	0.0279	0.4576	53.268	5	-1.797	~~1.860~~	0.0119
MWRC210R1	0.2356	1.1918	0.5027	0.3913	0.6238	18.040	5	0.903	~~1.860~~	0.0045

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.54387	1.035	-0.6898	1.10519
Bartlett's Test indicates equal variances (p = 0.49)	11.4508	26.217		
The control means are not significantly different (p = 0.94)	0.07852	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) ~~MLR 7-28-98~~ ~~MLR~~

~~Homoscedastic t Test indicates no significant differences~~

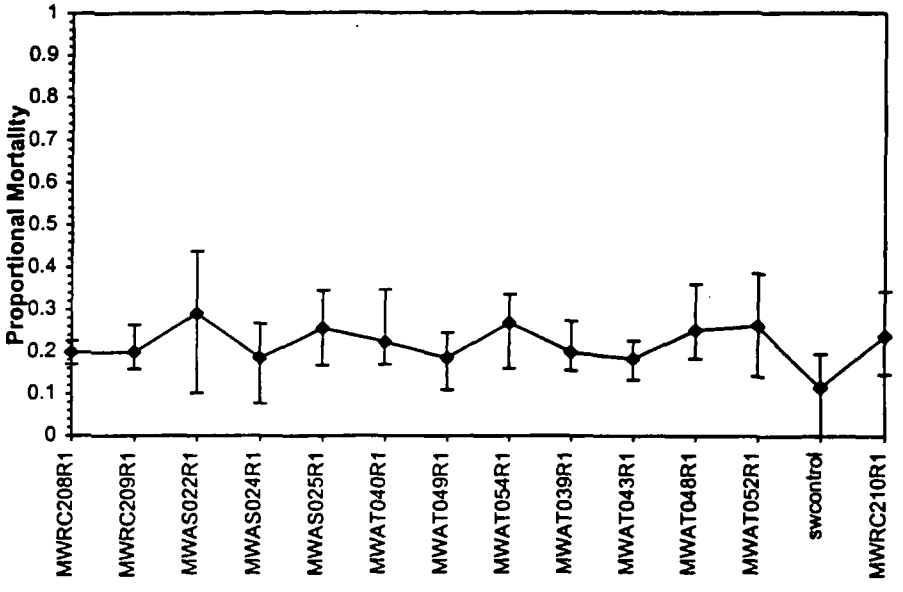
*significantly different from reference MWRC209R1 at p ≤ 0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Proportional Mortality

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Proportional Mortality

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.1703	0.2262	0.1734	0.2076	0.2138
MWRC210R1	0.3412	0.1454	0.2822	0.2138	0.1952
MWAS022R1	0.1019	0.3101	0.4375	0.2915	0.3101
MWAS024R1	0.2666	0.1579	0.0771	0.1703	0.2542
MWAS025R1	0.2822	0.3132	0.1672	0.3443	0.1672
MWAT040R1	0.3474	0.2324	0.1796	0.1858	0.1703
MWAT049R1	0.1796	0.1081	0.2449	0.2014	0.1889
MWAT054R1	0.3288	0.1610	0.2728	0.3350	0.2449
MWAT039R1	0.1920	0.1548	0.2014	0.1703	0.2728
MWAT043R1	0.1703	0.1765	0.1330	0.2262	0.2107
MWAT048R1	0.3599	0.1920	0.2418	0.2728	0.1827
MWAT052R1	0.2728	0.1423	0.2915	0.3847	0.2138
swcontrol	0.1548	0.1050	0.0000	0.1206	0.1952
MWRC209R1	0.1641	0.1579	0.2387	0.2635	0.1641

Comparison against MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.1983	0.8417	0.4609	0.4254	0.4957	6.859	5		for α = 0.10	
MWRC210R1	0.2356	1.0000	0.5027	0.3913	0.6238	18.040	5		is 1.397 MLR 7-28-98	
MWAS022R1	0.2902	1.2322	0.5599	0.3249	0.7228	25.842	5	0.749	~~1.860~~	0.0108
MWAS024R1	0.1852	0.7863	0.4373	0.2813	0.5426	24.174	5	-1.050	~~1.860~~	0.0072
MWAS025R1	0.2548	1.0818	0.5247	0.4212	0.6271	18.562	5	0.370	~~1.860~~	0.0066
MWAT040R1	0.2231	0.9472	0.4884	0.4254	0.6303	17.353	5	-0.256	~~1.860~~	0.0057
MWAT049R1	0.1846	0.7836	0.4411	0.3351	0.5177	15.113	5	-1.223	~~1.860~~	0.0047
MWAT054R1	0.2685	1.1398	0.5416	0.4128	0.6172	15.366	5	0.707	~~1.860~~	0.0056
MWAT039R1	0.1983	0.8417	0.4597	0.4043	0.5496	12.111	5	-0.904	~~1.860~~	0.0042
MWAT043R1	0.1833	0.7784	0.4410	0.3733	0.4957	10.852	5	-1.346	~~1.860~~	0.0039
MWAT048R1	0.2498	1.0607	0.5205	0.4417	0.6433	15.687	5	0.326	~~1.860~~	0.0055
MWAT052R1	0.2610	1.1082	0.5313	0.3868	0.6691	19.800	5	0.461	~~1.860~~	0.0072
swcontrol	0.1151	0.4887	0.3149	0.0279	0.4576	53.268	5	-2.202	~~1.860~~	0.0135
MWRC209R1	0.1976	0.8391	0.4584	0.4086	0.5391	13.408	5	-0.903	~~1.860~~	0.0045

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.54387	1.035	-0.6898	1.10519
Bartlett's Test indicates equal variances (p = 0.49)	11.4508	26.217		
The control means are not significantly different (p = 0.36)	0.97337	2.30601		

Hypothesis Test (1-tail, ~~0.05~~ MLR 7-28-98)

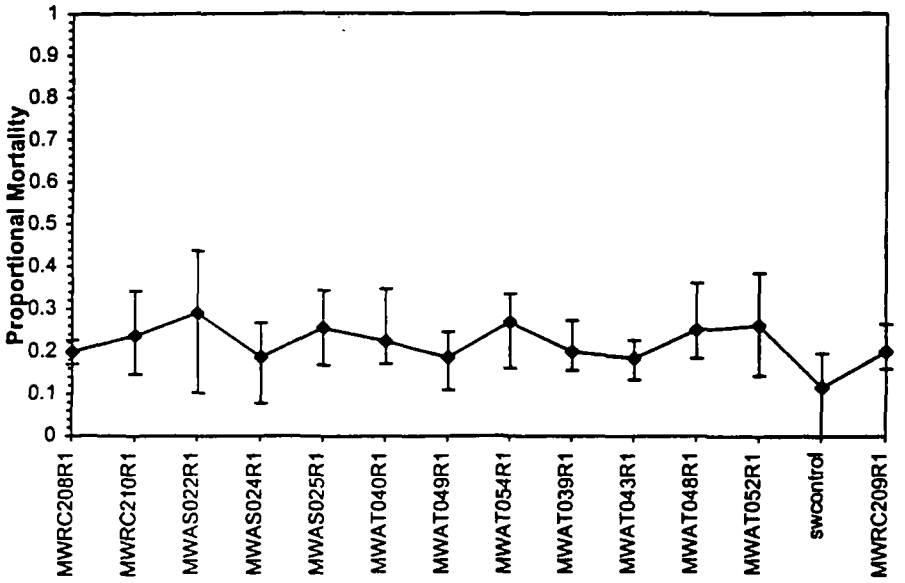
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Larval Sediment Test-Proportional Mortality

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Proportion Abnormal

Start Date:	6/4/98	Test ID:	590-3	~~Sample ID:~~	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0524	0.0281	0.0677	0.0431	0.0435
MWRC209R1	0.0483	0.0738	0.0449	0.0549	0.0669
MWAS022R1	0.1003	0.0586	0.0387	0.0614	0.0495
MWAS024R1	0.0169	0.0369	0.0572	0.0449	0.0417
MWAS025R1	0.0346	0.0136	0.0485	0.0142	0.0187
MWAT040R1	0.0381	0.0648	0.0492	0.0649	0.0449
MWAT049R1	0.0341	0.0557	0.0658	0.0584	0.0153
MWAT054R1	0.0787	0.0926	0.0513	0.1075	0.0288
MWAT039R1	0.0385	0.0588	0.0311	0.0262	0.0641
MWAT043R1	0.0150	0.0604	0.0753	0.0522	0.0551
MWAT048R1	0.0437	0.0538	0.0779	0.0385	0.0837
MWAT052R1	0.0427	0.0435	0.0658	0.0152	0.0277
swcontrol	0.0772	0.0556	0.0923	0.0530	0.0656
MWRC210R1	0.0236	0.0727	0.0519	0.0474	0.0579

Comparison to MWRC208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0470	0.8131	0.2164	0.1685	0.2632	15.993	5		for α=0.10 is 1.397 MLR 7-28-98	
MWRC209R1	0.0578	1.0000	0.2417	0.2135	0.2751	10.830	5			
MWAS022R1	0.0617	1.0684	0.2479	0.1979	0.3223	18.705	5	1.218	~~1.860~~	0.0012
MWAS024R1	0.0395	0.6846	0.1969	0.1306	0.2416	20.885	5	-0.810	~~1.860~~	0.0011
MWAS025R1	0.0259	0.4487	0.1565	0.1168	0.2221	29.566	5	-2.317	~~1.860~~	0.0012
MWAT040R1	0.0524	0.9070	0.2297	0.1964	0.2576	11.801	5	0.680	~~1.860~~	0.0007
MWAT049R1	0.0459	0.7943	0.2103	0.1241	0.2595	26.446	5	-0.206	~~1.860~~	0.0016
*MWAT054R1	0.0718	1.2426	0.2653	0.1706	0.3340	24.822	5	1.471	~~1.860~~	0.0021
MWAT039R1	0.0437	0.7574	0.2077	0.1626	0.2560	19.821	5	-0.363	~~1.860~~	0.0011
MWAT043R1	0.0516	0.8932	0.2233	0.1227	0.2779	26.463	5	0.225	~~1.860~~	0.0017
MWAT048R1	0.0595	1.0302	0.2437	0.1974	0.2934	17.571	5	1.108	~~1.860~~	0.0011
MWAT052R1	0.0390	0.6746	0.1936	0.1234	0.2594	26.386	5	-0.824	~~1.860~~	0.0014
*swcontrol	0.0687	1.1902	0.2639	0.2323	0.3087	12.003	5	2.265	~~1.860~~	0.0008
MWRC210R1	0.0507	0.8782	0.2240	0.1542	0.2731	19.590	5	0.303	~~1.860~~	0.0012

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.60992	1.035	-0.3732	-0.4028
Bartlett's Test indicates equal variances (p = 0.95)	5.16253	26.217		
The control means are not significantly different (p = 0.23)	1.30278	2.30601		

Hypothesis Test (1-tail, 0.05) MLR 7-28-98

Homoscedastic t Test indicates significant differences

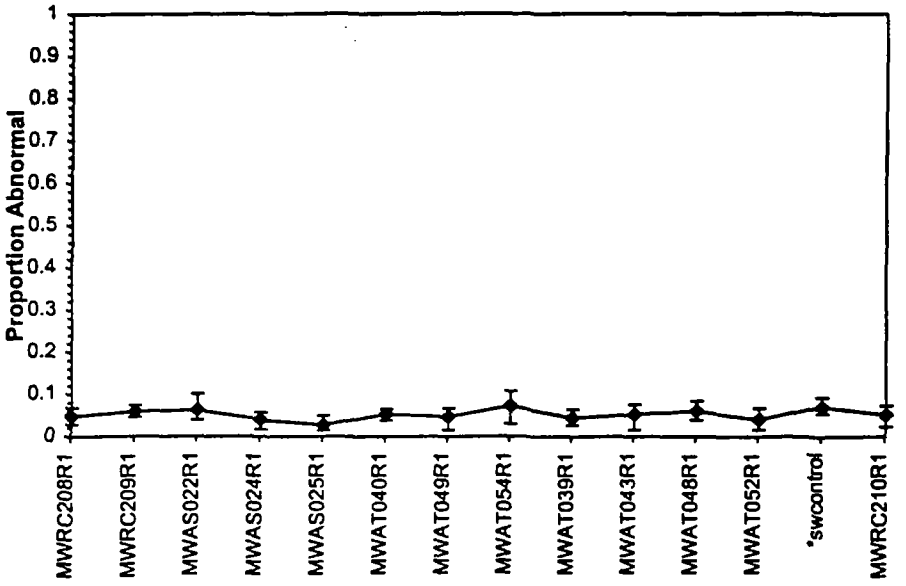
* significantly different from MWRC208R1 reference at p ≤ 0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Proportion Abnormal

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Proportion Abnormal

Start Date:	6/4/98	Test ID:	590-3	~~Sample ID:~~	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0524	0.0281	0.0677	0.0431	0.0435
MWRC209R1	0.0483	0.0738	0.0449	0.0549	0.0669
MWAS022R1	0.1003	0.0586	0.0387	0.0614	0.0495
MWAS024R1	0.0169	0.0369	0.0572	0.0449	0.0417
MWAS025R1	0.0346	0.0136	0.0485	0.0142	0.0187
MWAT040R1	0.0381	0.0648	0.0492	0.0649	0.0449
MWAT049R1	0.0341	0.0557	0.0658	0.0584	0.0153
MWAT054R1	0.0787	0.0926	0.0513	0.1075	0.0288
MWAT039R1	0.0385	0.0588	0.0311	0.0262	0.0641
MWAT043R1	0.0150	0.0604	0.0753	0.0522	0.0551
MWAT048R1	0.0437	0.0538	0.0779	0.0385	0.0837
MWAT052R1	0.0427	0.0435	0.0658	0.0152	0.0277
swcontrol	0.0772	0.0556	0.0923	0.0530	0.0656
MWRC210R1	0.0236	0.0727	0.0519	0.0474	0.0579

Comparison to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0470	0.8131	0.2164	0.1685	0.2632	15.993	5		for α=0.10 is 1.397 MLR 7-28-98	
MWRC209R1	0.0578	1.0000	0.2417	0.2135	0.2751	10.830	5			
MWAS022R1	0.0617	1.0684	0.2479	0.1979	0.3223	18.705	5	0.262	~~1.860~~	0.0011
MWAS024R1	0.0395	0.6846	0.1969	0.1306	0.2416	20.885	5	-2.052	~~1.860~~	0.0009
MWAS025R1	0.0259	0.4487	0.1565	0.1168	0.2221	29.566	5	-3.582	~~1.860~~	0.0011
MWAT040R1	0.0524	0.9070	0.2297	0.1964	0.2576	11.801	5	-0.707	~~1.860~~	0.0005
MWAT049R1	0.0459	0.7943	0.2103	0.1241	0.2595	26.446	5	-1.140	~~1.860~~	0.0014
MWAT054R1	0.0718	1.2426	0.2653	0.1706	0.3340	24.822	5	0.746	~~1.860~~	0.0019
MWAT039R1	0.0437	0.7574	0.2077	0.1626	0.2560	19.821	5	-1.559	~~1.860~~	0.0009
MWAT043R1	0.0516	0.8932	0.2233	0.1227	0.2779	26.463	5	-0.636	~~1.860~~	0.0016
MWAT048R1	0.0595	1.0302	0.2437	0.1974	0.2934	17.571	5	0.089	~~1.860~~	0.0009
MWAT052R1	0.0390	0.6746	0.1936	0.1234	0.2594	26.386	5	-1.871	~~1.860~~	0.0012
swcontrol	0.0687	1.1902	0.2639	0.2323	0.3087	12.003	5	1.211	~~1.860~~	0.0006
MWRC210R1	0.0507	0.8782	0.2240	0.1542	0.2731	19.590	5	-0.775	~~1.860~~	0.0010

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.61935	1.035	-0.3791	-0.3455
Bartlett's Test indicates equal variances (p = 0.90)	6.32839	26.217		
The control means are not significantly different (p = 0.23)	1.30278	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLR 7-28-98

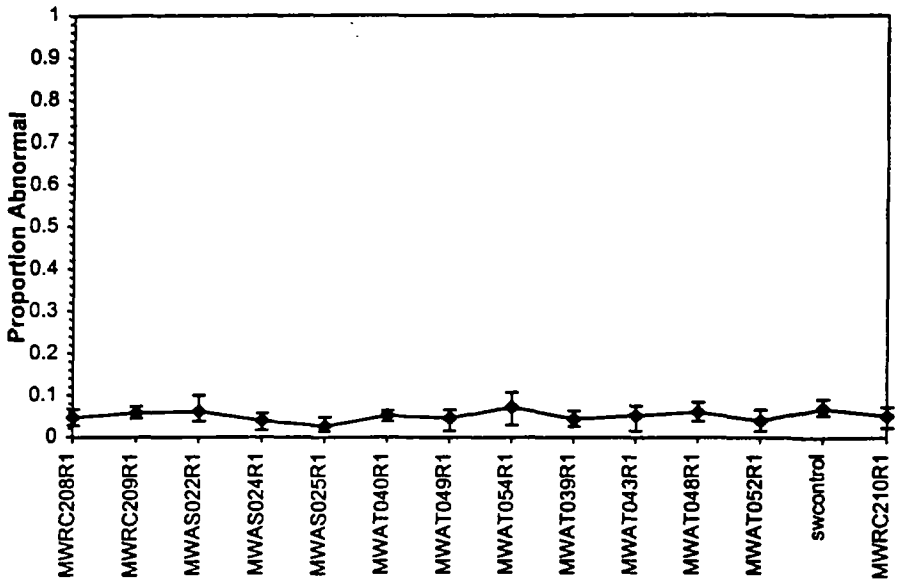
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Larval Sediment Test-Proportion Abnormal

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Proportion Abnormal

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0524	0.0281	0.0677	0.0431	0.0435
MWRC210R1	0.0236	0.0727	0.0519	0.0474	0.0579
MWAS022R1	0.1003	0.0586	0.0387	0.0614	0.0495
MWAS024R1	0.0169	0.0369	0.0572	0.0449	0.0417
MWAS025R1	0.0346	0.0136	0.0485	0.0142	0.0187
MWAT040R1	0.0381	0.0648	0.0492	0.0649	0.0449
MWAT049R1	0.0341	0.0557	0.0658	0.0584	0.0153
MWAT054R1	0.0787	0.0926	0.0513	0.1075	0.0288
MWAT039R1	0.0385	0.0588	0.0311	0.0262	0.0641
MWAT043R1	0.0150	0.0604	0.0753	0.0522	0.0551
MWAT048R1	0.0437	0.0538	0.0779	0.0385	0.0837
MWAT052R1	0.0427	0.0435	0.0658	0.0152	0.0277
swcontrol	0.0772	0.0556	0.0923	0.0530	0.0656
MWRC209R1	0.0483	0.0738	0.0449	0.0549	0.0669

Comparison against MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0470	0.9260	0.2164	0.1685	0.2632	15.993	5		for α=0.10 MLR is 1.397 1-28-98	
MWRC210R1	0.0507	1.0000	0.2240	0.1542	0.2731	19.590	5			
MWAS022R1	0.0617	1.2166	0.2479	0.1979	0.3223	18.705	5	0.839	~~1.860~~	0.0015
MWAS024R1	0.0395	0.7796	0.1969	0.1306	0.2416	20.885	5	-1.005	~~1.860~~	0.0013
MWAS025R1	0.0259	0.5110	0.1565	0.1168	0.2221	29.566	5	-2.365	~~1.860~~	0.0015
MWAT040R1	0.0524	1.0329	0.2297	0.1964	0.2576	11.801	5	0.251	~~1.860~~	0.0010
MWAT049R1	0.0459	0.9045	0.2103	0.1241	0.2595	26.446	5	-0.430	~~1.860~~	0.0019
MWAT054R1	0.0718	1.4150	0.2653	0.1706	0.3340	24.822	5	1.169	~~1.860~~	0.0023
MWAT039R1	0.0437	0.8625	0.2077	0.1626	0.2560	19.821	5	-0.605	~~1.860~~	0.0013
MWAT043R1	0.0516	1.0171	0.2233	0.1227	0.2779	26.463	5	-0.021	~~1.860~~	0.0020
MWAT048R1	0.0595	1.1731	0.2437	0.1974	0.2934	17.571	5	0.719	~~1.860~~	0.0014
MWAT052R1	0.0390	0.7682	0.1936	0.1234	0.2594	26.386	5	-1.007	~~1.860~~	0.0017
* swcontrol	0.0687	1.3553	0.2639	0.2323	0.3087	12.003	5	1.651	~~1.860~~	0.0011
MWRC209R1	0.0578	1.1387	0.2417	0.2135	0.2751	10.830	5	0.775	~~1.860~~	0.0010

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.61935	1.035	-0.3791	-0.3455
Bartlett's Test indicates equal variances (p = 0.90)	6.32839	26.217		
The control means are not significantly different (p = 0.77)	0.30285	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLR 2-28-98

Homoscedastic t Test indicates no ~~significant differences~~ MLR

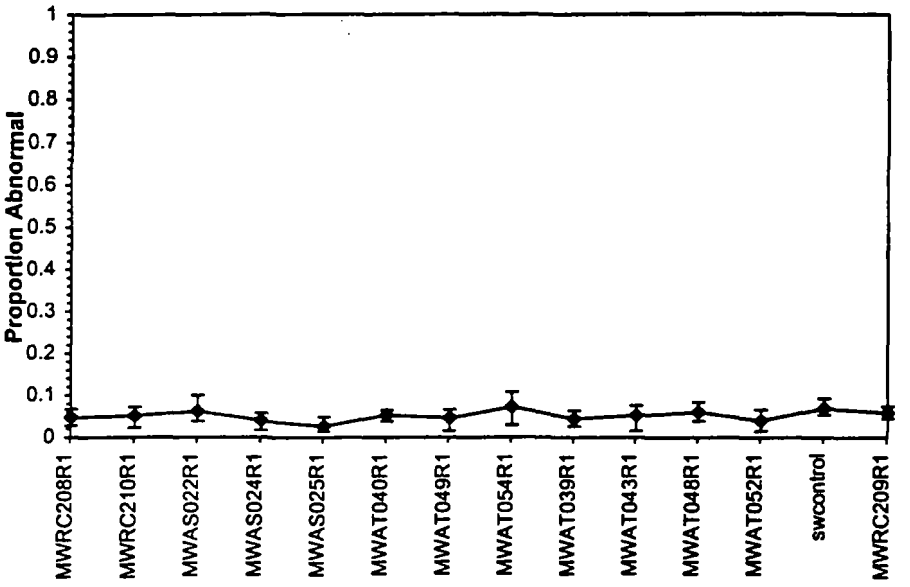
* significantly different from reference MWRC210R1 at α=0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Proportion Abnormal

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Comb Abnormal + Dead

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.2138	0.2480	0.2293	0.2418	0.2480
MWRC209R1	0.2045	0.2200	0.2728	0.3039	0.2200
MWAS022R1	0.1920	0.3505	0.4593	0.3350	0.3443
MWAS024R1	0.2791	0.1889	0.1299	0.2076	0.2853
MWAS025R1	0.3070	0.3226	0.2076	0.3536	0.1827
MWAT040R1	0.3723	0.2822	0.2200	0.2387	0.2076
MWAT049R1	0.2076	0.1579	0.2946	0.2480	0.2014
MWAT054R1	0.3816	0.2387	0.3101	0.4065	0.2666
MWAT039R1	0.2231	0.2045	0.2262	0.1920	0.3195
MWAT043R1	0.1827	0.2262	0.1983	0.2666	0.2542
MWAT048R1	0.3878	0.2356	0.3008	0.3008	0.2511
MWAT052R1	0.3039	0.1796	0.3381	0.3940	0.2356
swcontrol	0.2200	0.1548	0.0833	0.1672	0.2480
MWRC210R1	0.3567	0.2076	0.3195	0.2511	0.2418

Comparison to MWRC 208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.2362	0.9669	0.5073	0.4807	0.5213	3.423	5		for α=0.10 is 1.397 MLR 7-28-98	
MWRC209R1	0.2443	1.0000	0.5158	0.4692	0.5839	9.433	5			
* MWAS022R1	0.3362	1.3766	0.6152	0.4536	0.7446	16.920	5	2.286	~~1.860~~	0.0041
MWAS024R1	0.2181	0.8931	0.4823	0.3687	0.5635	16.765	5	-0.677	~~1.860~~	0.0025
MWAS025R1	0.2747	1.1247	0.5486	0.4417	0.6369	15.653	5	1.053	~~1.860~~	0.0029
MWAT040R1	0.2641	1.0814	0.5376	0.4731	0.6562	13.771	5	0.890	~~1.860~~	0.0022
MWAT049R1	0.2219	0.9084	0.4884	0.4086	0.5737	12.744	5	-0.655	~~1.860~~	0.0016
* MWAT054R1	0.3207	1.3130	0.6002	0.5104	0.6913	12.930	5	2.610	~~1.860~~	0.0024
MWAT039R1	0.2331	0.9542	0.5022	0.4536	0.6007	11.478	5	-0.189	~~1.860~~	0.0013
MWAT043R1	0.2256	0.9237	0.4940	0.4417	0.5426	8.675	5	-0.646	~~1.860~~	0.0008
* MWAT048R1	0.2952	1.2087	0.5730	0.5067	0.6723	11.267	5	2.196	~~1.860~~	0.0017
MWAT052R1	0.2902	1.1883	0.5655	0.4376	0.6786	16.767	5	1.349	~~1.860~~	0.0035
swcontrol	0.1746	0.7150	0.4256	0.2927	0.5213	20.752	5	-2.032	~~1.860~~	0.0030
MWRC210R1	0.2753	1.1272	0.5505	0.4731	0.6401	12.363	5	1.376	~~1.860~~	0.0018

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.46836	1.035	-0.1114	-0.4308
Bartlett's Test indicates equal variances (p = 0.47)	11.6446	26.217		
The control means are not significantly different (p = 0.72)	0.36808	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLR 7-28-98

Homoscedastic t Test indicates significant differences

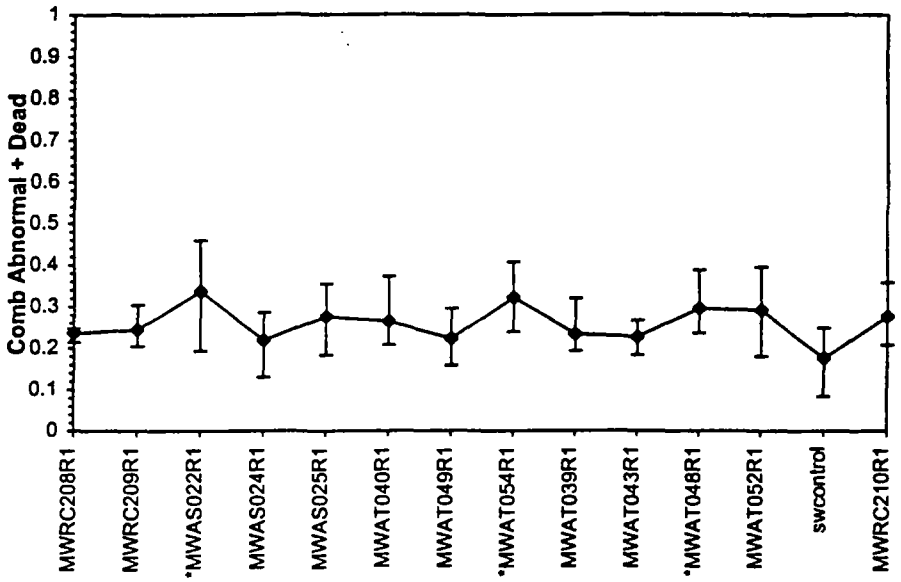
* significantly different from reference MWRC 208R1 at p ≤ 0.10

ToxCalc v5.0.15N

Larval Sediment Test-Comb Abnormal + Dead

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Larval Sediment Test-Comb Abnormal + Dead

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.2138	0.2480	0.2293	0.2418	0.2480
MWRC209R1	0.2045	0.2200	0.2728	0.3039	0.2200
MWAS022R1	0.1920	0.3505	0.4593	0.3350	0.3443
MWAS024R1	0.2791	0.1889	0.1299	0.2076	0.2853
MWAS025R1	0.3070	0.3226	0.2076	0.3536	0.1827
MWAT040R1	0.3723	0.2822	0.2200	0.2387	0.2076
MWAT049R1	0.2076	0.1579	0.2946	0.2480	0.2014
MWAT054R1	0.3816	0.2387	0.3101	0.4065	0.2666
MWAT039R1	0.2231	0.2045	0.2262	0.1920	0.3195
MWAT043R1	0.1827	0.2262	0.1983	0.2666	0.2542
MWAT048R1	0.3878	0.2356	0.3008	0.3008	0.2511
MWAT052R1	0.3039	0.1796	0.3381	0.3940	0.2356
swcontrol	0.2200	0.1548	0.0833	0.1672	0.2480
MWRC210R1	0.3567	0.2076	0.3195	0.2511	0.2418

Comparison to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.2362	0.9669	0.5073	0.4807	0.5213	3.423	5		for α=0.10	
MWRC209R1	0.2443	1.0000	0.5158	0.4692	0.5839	9.433	5		is 1.397 MLR 7-28-98	
* MWAS022R1	0.3362	1.3766	0.6152	0.4536	0.7446	16.920	5	1.934	~~1.860~~	0.0049
MWAS024R1	0.2181	0.8931	0.4823	0.3687	0.5635	16.765	5	-0.795	~~1.860~~	0.0033
MWAS025R1	0.2747	1.1247	0.5486	0.4417	0.6369	15.653	5	0.742	~~1.860~~	0.0036
MWAT040R1	0.2641	1.0814	0.5376	0.4731	0.6562	13.771	5	0.549	~~1.860~~	0.0029
MWAT049R1	0.2219	0.9084	0.4884	0.4086	0.5737	12.744	5	-0.776	~~1.860~~	0.0023
* MWAT054R1	0.3207	1.3130	0.6002	0.5104	0.6913	12.930	5	2.059	~~1.860~~	0.0031
MWAT039R1	0.2331	0.9542	0.5022	0.4536	0.6007	11.478	5	-0.403	~~1.860~~	0.0021
MWAT043R1	0.2256	0.9237	0.4940	0.4417	0.5426	8.675	5	-0.754	~~1.860~~	0.0016
* MWAT048R1	0.2952	1.2087	0.5730	0.5067	0.6723	11.267	5	1.581	~~1.860~~	0.0024
MWAT052R1	0.2902	1.1883	0.5655	0.4376	0.6786	16.767	5	1.042	~~1.860~~	0.0042
swcontrol	0.1746	0.7150	0.4256	0.2927	0.5213	20.752	5	-2.002	~~1.860~~	0.0038
MWRC210R1	0.2753	1.1272	0.5505	0.4731	0.6401	12.363	5	0.928	~~1.860~~	0.0026

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.45784	1.035	-0.095	-0.5588
Bartlett's Test indicates equal variances (p = 0.94)	5.44678	26.217		
The control means are not significantly different (p = 0.72)	0.36808	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLR 7-28-98

Homoscedastic t Test indicates significant differences

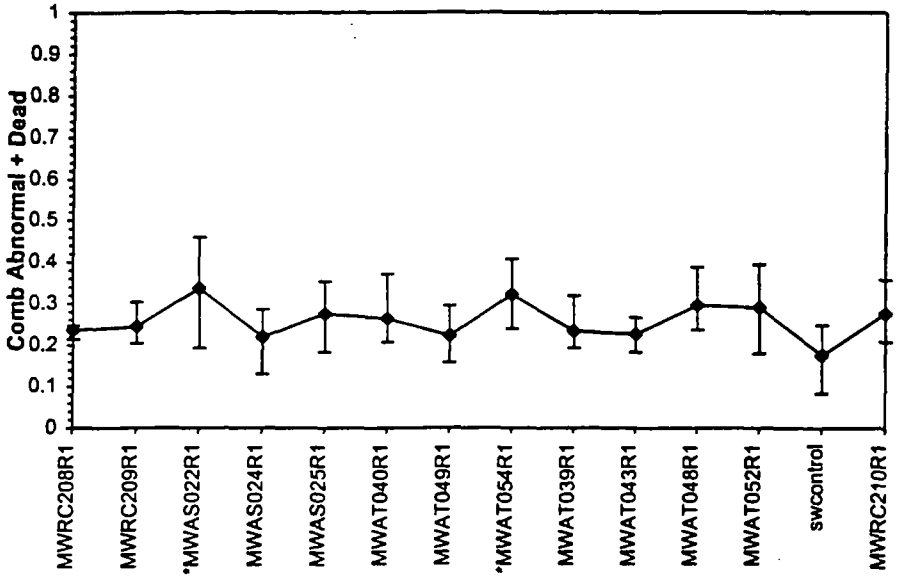
*significantly different from reference MWRC209R1 at p ≤ 0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Comb Abnormal + Dead

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Larval Sediment Test-Comb Abnormal + Dead

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.2138	0.2480	0.2293	0.2418	0.2480
MWRC210R1	0.3567	0.2076	0.3195	0.2511	0.2418
MWAS022R1	0.1920	0.3505	0.4593	0.3350	0.3443
MWAS024R1	0.2791	0.1889	0.1299	0.2076	0.2853
MWAS025R1	0.3070	0.3226	0.2076	0.3536	0.1827
MWAT040R1	0.3723	0.2822	0.2200	0.2387	0.2076
MWAT049R1	0.2076	0.1579	0.2946	0.2480	0.2014
MWAT054R1	0.3816	0.2387	0.3101	0.4065	0.2666
MWAT039R1	0.2231	0.2045	0.2262	0.1920	0.3195
MWAT043R1	0.1827	0.2262	0.1983	0.2666	0.2542
MWAT048R1	0.3878	0.2356	0.3008	0.3008	0.2511
MWAT052R1	0.3039	0.1796	0.3381	0.3940	0.2356
swcontrol	0.2200	0.1548	0.0833	0.1672	0.2480
MWRC209R1	0.2045	0.2200	0.2728	0.3039	0.2200

Comparison against MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.2362	0.8578	0.5073	0.4807	0.5213	3.423	5		for α=0.10 is 1.397 MLR 7-25-98	
MWRC210R1	0.2753	1.0000	0.5505	0.4731	0.6401	12.363	5			
MWAS022R1	0.3362	1.2212	0.6152	0.4536	0.7446	16.920	5	1.163	~~1.860~~	0.0058
MWAS024R1	0.2181	0.7923	0.4823	0.3687	0.5635	16.765	5	-1.444	~~1.860~~	0.0042
MWAS025R1	0.2747	0.9977	0.5486	0.4417	0.6369	15.653	5	-0.040	~~1.860~~	0.0045
MWAT040R1	0.2641	0.9594	0.5376	0.4731	0.6562	13.771	5	-0.288	~~1.860~~	0.0038
MWAT049R1	0.2219	0.8059	0.4884	0.4086	0.5737	12.744	5	-1.507	~~1.860~~	0.0032
MWAT054R1	0.3207	1.1648	0.6002	0.5104	0.6913	12.930	5	1.075	~~1.860~~	0.0040
MWAT039R1	0.2331	0.8465	0.5022	0.4536	0.6007	11.478	5	-1.211	~~1.860~~	0.0030
MWAT043R1	0.2256	0.8194	0.4940	0.4417	0.5426	8.675	5	-1.573	~~1.860~~	0.0024
MWAT048R1	0.2952	1.0722	0.5730	0.5067	0.6723	11.267	5	0.535	~~1.860~~	0.0033
MWAT052R1	0.2902	1.0542	0.5655	0.4376	0.6786	16.767	5	0.286	~~1.860~~	0.0051
swcontrol	0.1746	0.6343	0.4256	0.2927	0.5213	20.752	5	-2.507	~~1.860~~	0.0046
MWRC209R1	0.2443	0.8871	0.5158	0.4692	0.5839	9.433	5	-0.928	~~1.860~~	0.0026

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.45784	1.035	-0.095	-0.5588
Bartlett's Test indicates equal variances (p = 0.94)	5.44678	26.217		
The control means are not significantly different (p = 0.21)	1.37579	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLR 7-25-98

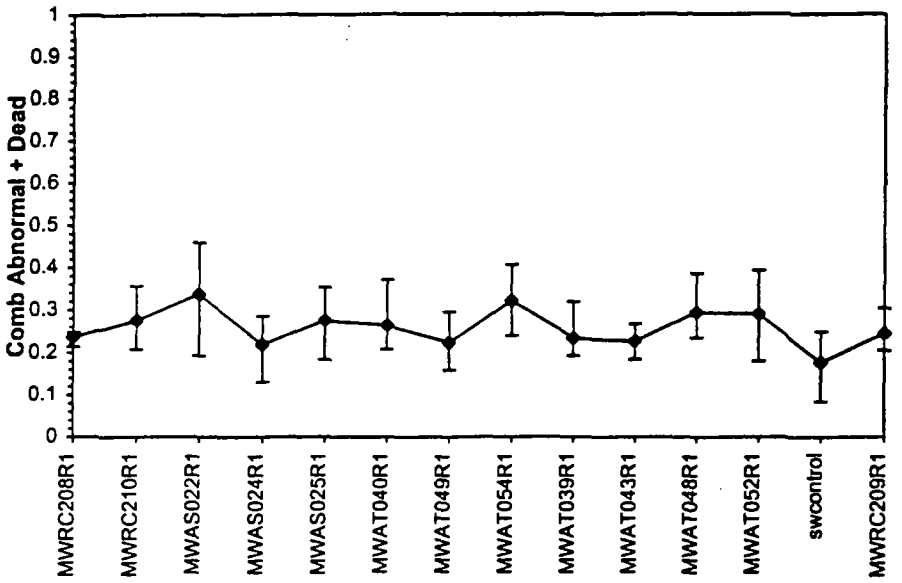
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Larval Sediment Test-Comb Abnormal + Dead

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Larval Sediment Test-Normalized Prop. Mort

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0645	0.1275	0.0680	0.1065	0.1135
MWRC209R1	0.0575	0.0505	0.1416	0.1696	0.0575
MWAS022R1	0.0000	0.2221	0.3658	0.2011	0.2221
MWAS024R1	0.1731	0.0505	0.0000	0.0645	0.1591
MWAS025R1	0.1906	0.2256	0.0610	0.2607	0.0610
MWAT040R1	0.2642	0.1345	0.0750	0.0820	0.0645
MWAT049R1	0.0750	0.0000	0.1486	0.0995	0.0855
MWAT054R1	0.2432	0.0540	0.1801	0.2502	0.1486
MWAT039R1	0.0890	0.0470	0.0995	0.0645	0.1801
MWAT043R1	0.0645	0.0715	0.0224	0.1275	0.1100
MWAT048R1	0.2782	0.0890	0.1451	0.1801	0.0785
MWAT052R1	0.1801	0.0329	0.2011	0.3062	0.1135
swcontrol	0.0470	0.0000	0.0000	0.0084	0.0925
MWRC210R1	0.2572	0.0364	0.1906	0.1135	0.0925

Comparison to MWRC208R1.

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0960	1.0074	0.3124	0.2567	0.3652	15.710	5		for α=0.10 is 1.397 MLR 7-28-98	
MWRC209R1	0.0953	1.0000	0.3042	0.2266	0.4244	30.688	5			
MWAS022R1	0.2022	2.1221	0.4252	0.0296	0.6495	54.786	5	1.060	~~1.860~~	0.0211
MWAS024R1	0.0894	0.9382	0.2704	0.0296	0.4291	59.861	5	-0.554	~~1.860~~	0.0106
MWAS025R1	0.1598	1.6765	0.3963	0.2495	0.5359	34.642	5	1.288	~~1.860~~	0.0079
MWAT040R1	0.1240	1.3015	0.3480	0.2567	0.5398	33.451	5	0.631	~~1.860~~	0.0059
MWAT049R1	0.0817	0.8574	0.2641	0.0296	0.3957	52.465	5	-0.735	~~1.860~~	0.0080
* MWAT054R1	0.1752	1.8382	0.4216	0.2344	0.5238	27.885	5	1.917	~~1.860~~	0.0060
MWAT039R1	0.0960	1.0074	0.3075	0.2184	0.4383	27.124	5	-0.113	~~1.860~~	0.0035
MWAT043R1	0.0792	0.8309	0.2762	0.1503	0.3652	30.297	5	-0.834	~~1.860~~	0.0035
* MWAT048R1	0.1542	1.6176	0.3943	0.2840	0.5556	27.923	5	1.520	~~1.860~~	0.0054
MWAT052R1	0.1668	1.7500	0.4032	0.1825	0.5864	37.386	5	1.281	~~1.860~~	0.0093
swcontrol	0.0296	0.3103	0.1357	0.0296	0.3090	91.248	5	-2.966	~~1.860~~	0.0066
MWRC210R1	0.1381	1.4485	0.3657	0.1921	0.5319	35.881	5	0.851	~~1.860~~	0.0073

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.54905	1.035	-0.6381	0.78205
Bartlett's Test indicates equal variances (p = 0.53)	10.968	26.217		
The control means are not significantly different (p = 0.87)	0.17356	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLR 7-28-98

Homoscedastic t Test indicates significant differences

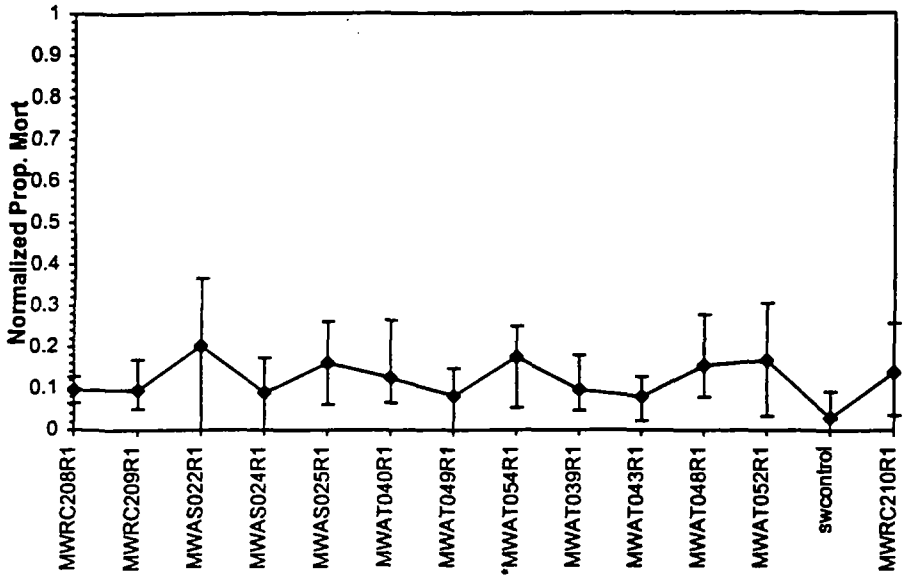
Significantly different from reference MWRC208R1 at p ≤ 0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Normalized Prop. Mort

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Larval Sediment Test-Normalized Prop. Mort

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0645	0.1275	0.0680	0.1065	0.1135
MWRC209R1	0.0575	0.0505	0.1416	0.1696	0.0575
MWAS022R1	0.0000	0.2221	0.3658	0.2011	0.2221
MWAS024R1	0.1731	0.0505	0.0000	0.0645	0.1591
MWAS025R1	0.1906	0.2256	0.0610	0.2607	0.0610
MWAT040R1	0.2642	0.1345	0.0750	0.0820	0.0645
MWAT049R1	0.0750	0.0000	0.1486	0.0995	0.0855
MWAT054R1	0.2432	0.0540	0.1801	0.2502	0.1486
MWAT039R1	0.0890	0.0470	0.0995	0.0645	0.1801
MWAT043R1	0.0645	0.0715	0.0224	0.1275	0.1100
MWAT048R1	0.2782	0.0890	0.1451	0.1801	0.0785
MWAT052R1	0.1801	0.0329	0.2011	0.3062	0.1135
swcontrol	0.0470	0.0000	0.0000	0.0084	0.0925
MWRC210R1	0.2572	0.0364	0.1906	0.1135	0.0925

Comparison to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0960	1.0074	0.3124	0.2567	0.3652	15.710	5		for α=0.10	
MWRC209R1	0.0953	1.0000	0.3042	0.2266	0.4244	30.688	5		is 1.397 MLR 7-28-98	
MWAS022R1	0.2022	2.1221	0.4252	0.0296	0.6495	54.786	5	1.078	~~1.860~~	0.0234
MWAS024R1	0.0894	0.9382	0.2704	0.0296	0.4291	59.861	5	-0.404	~~1.860~~	0.0130
MWAS025R1	0.1598	1.6765	0.3963	0.2495	0.5359	34.642	5	1.241	~~1.860~~	0.0103
MWAT040R1	0.1240	1.3015	0.3480	0.2567	0.5398	33.451	5	0.657	~~1.860~~	0.0083
MWAT049R1	0.0817	0.8574	0.2641	0.0296	0.3957	52.465	5	-0.537	~~1.860~~	0.0104
*MWAT054R1	0.1752	1.8382	0.4216	0.2344	0.5238	27.885	5	1.749	~~1.860~~	0.0084
MWAT039R1	0.0960	1.0074	0.3075	0.2184	0.4383	27.124	5	0.059	~~1.860~~	0.0058
MWAT043R1	0.0792	0.8309	0.2762	0.1503	0.3652	30.297	5	-0.499	~~1.860~~	0.0058
MWAT048R1	0.1542	1.6176	0.3943	0.2840	0.5556	27.923	5	1.396	~~1.860~~	0.0077
MWAT052R1	0.1668	1.7500	0.4032	0.1825	0.5864	37.386	5	1.249	~~1.860~~	0.0117
swcontrol	0.0296	0.3103	0.1357	0.0296	0.3090	91.248	5	-2.429	~~1.860~~	0.0089
MWRC210R1	0.1381	1.4485	0.3657	0.1921	0.5319	35.881	5	0.854	~~1.860~~	0.0096

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.49536	1.035	-0.5998	0.59821
Bartlett's Test indicates equal variances (p = 0.82)	7.53989	26.217		
The control means are not significantly different (p = 0.87)	0.17356	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) ~~MLR 7-28-98~~

Homoscedastic t Test indicates ~~no significant differences~~ MLR 7-28-98

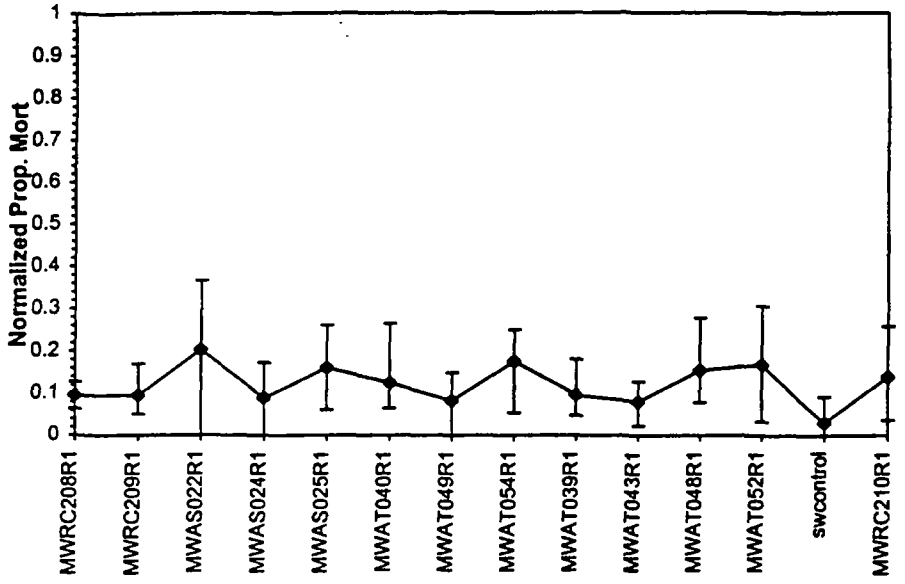
* significantly different from reference MWRC209R1 at P ≤ 0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Normalized Prop. Mort

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Larval Sediment Test-Normalized Prop. Mort

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0645	0.1275	0.0680	0.1065	0.1135
MWRC210R1	0.2572	0.0364	0.1906	0.1135	0.0925
MWAS022R1	0.0000	0.2221	0.3658	0.2011	0.2221
MWAS024R1	0.1731	0.0505	0.0000	0.0645	0.1591
MWAS025R1	0.1906	0.2256	0.0610	0.2607	0.0610
MWAT040R1	0.2642	0.1345	0.0750	0.0820	0.0645
MWAT049R1	0.0750	0.0000	0.1486	0.0995	0.0855
MWAT054R1	0.2432	0.0540	0.1801	0.2502	0.1486
MWAT039R1	0.0890	0.0470	0.0995	0.0645	0.1801
MWAT043R1	0.0645	0.0715	0.0224	0.1275	0.1100
MWAT048R1	0.2782	0.0890	0.1451	0.1801	0.0785
MWAT052R1	0.1801	0.0329	0.2011	0.3062	0.1135
swcontrol	0.0470	0.0000	0.0000	0.0084	0.0925
MWRC209R1	0.0575	0.0505	0.1416	0.1696	0.0575

Comparison against MWRC210R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0960	0.6954	0.3124	0.2567	0.3652	15.710	5			
MWRC210R1	0.1381	1.0000	0.3657	0.1921	0.5319	35.881	5			
MWAS022R1	0.2022	1.4650	0.4252	0.0296	0.6495	54.786	5	0.497	1.860	0.0266
MWAS024R1	0.0894	0.6477	0.2704	0.0296	0.4291	59.861	5	-1.022	1.860	0.0162
MWAS025R1	0.1598	1.1574	0.3963	0.2495	0.5359	34.642	5	0.361	1.860	0.0134
MWAT040R1	0.1240	0.8985	0.3480	0.2567	0.5398	33.451	5	-0.226	1.860	0.0114
MWAT049R1	0.0817	0.5919	0.2641	0.0296	0.3957	52.465	5	-1.191	1.860	0.0135
MWAT054R1	0.1752	1.2690	0.4216	0.2344	0.5238	27.885	5	0.709	1.860	0.0115
MWAT039R1	0.0960	0.6954	0.3075	0.2184	0.4383	27.124	5	-0.837	1.860	0.0090
MWAT043R1	0.0792	0.5736	0.2762	0.1503	0.3652	30.297	5	-1.286	1.860	0.0090
MWAT048R1	0.1542	1.1168	0.3943	0.2840	0.5556	27.923	5	0.374	1.860	0.0109
MWAT052R1	0.1668	1.2081	0.4032	0.1825	0.5864	37.386	5	0.420	1.860	0.0149
swcontrol	0.0296	0.2142	0.1357	0.0296	0.3090	91.248	5	-2.851	1.860	0.0121
MWRC209R1	0.0953	0.6904	0.3042	0.2266	0.4244	30.688	5	-0.854	1.860	0.0096

at $\alpha = 0.10$ is 1.397 MLK 7-28-98

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.49536	1.035	-0.5998	0.59821
Bartlett's Test indicates equal variances (p = 0.82)	7.53989	26.217		
The control means are not significantly different (p = 0.42)	0.85118	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MLK 7-28-98

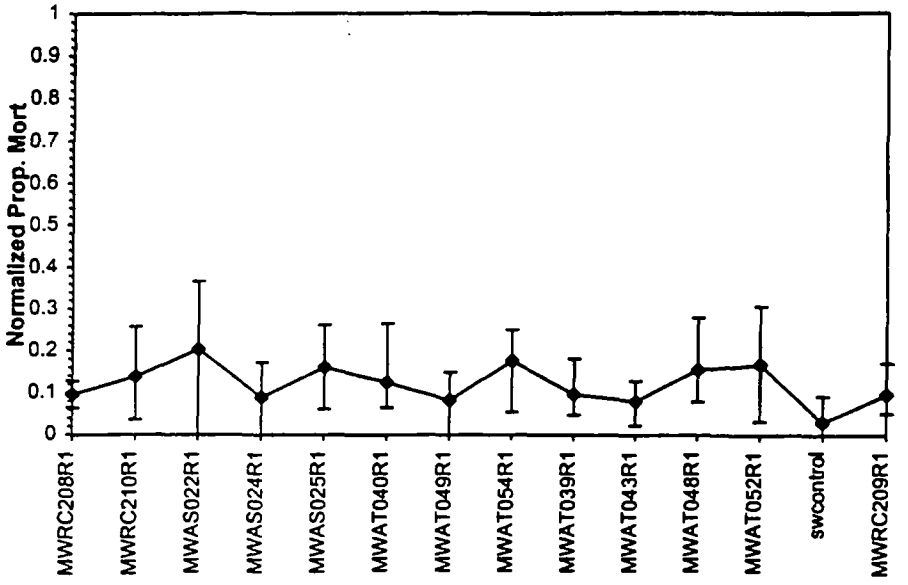
Homoscedastic t Test indicates no significant differences

ToxCalc v5.0.15N

Larval Sediment Test-Normalized Prop. Mort

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Larval Sediment Test-Norm.Comb. Mort+Abn

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0474	0.0889	0.0663	0.0813	0.0889
MWRC209R1	0.0361	0.0550	0.1190	0.1566	0.0550
MWAS022R1	0.0211	0.2131	0.3449	0.1943	0.2056
MWAS024R1	0.1265	0.0173	0.0000	0.0399	0.1340
MWAS025R1	0.1604	0.1792	0.0399	0.2169	0.0098
MWAT040R1	0.2395	0.1303	0.0550	0.0776	0.0399
MWAT049R1	0.0399	0.0000	0.1453	0.0889	0.0324
MWAT054R1	0.2508	0.0776	0.1642	0.2809	0.1114
MWAT039R1	0.0587	0.0361	0.0625	0.0211	0.1755
MWAT043R1	0.0098	0.0625	0.0286	0.1114	0.0964
MWAT048R1	0.2583	0.0738	0.1529	0.1529	0.0926
MWAT052R1	0.1566	0.0060	0.1980	0.2658	0.0738
swcontrol	0.0550	0.0000	0.0000	0.0000	0.0889
MWRC210R1	0.2206	0.0399	0.1755	0.0926	0.0813

Comparison to MWRC 208R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0745	0.8839	0.2749	0.2196	0.3027	12.889	5		for α=0.10 is 1.397 MJR 7-28-98	
MWRC209R1	0.0843	1.0000	0.2847	0.1913	0.4069	31.816	5			
* MWAS022R1	0.1958	2.3214	0.4361	0.1457	0.6277	40.465	5	2.002	~~1.860~~	0.0120
MWAS024R1	0.0636	0.7536	0.2205	0.0307	0.3748	67.490	5	-0.796	~~1.860~~	0.0087
MWAS025R1	0.1212	1.4375	0.3268	0.0991	0.4844	51.191	5	0.678	~~1.860~~	0.0109
MWAT040R1	0.1084	1.2857	0.3201	0.2011	0.5113	38.746	5	0.784	~~1.860~~	0.0062
MWAT049R1	0.0613	0.7268	0.2213	0.0307	0.3911	61.390	5	-0.853	~~1.860~~	0.0073
* MWAT054R1	0.1770	2.0982	0.4246	0.2822	0.5586	27.705	5	2.724	~~1.860~~	0.0056
MWAT039R1	0.0708	0.8393	0.2533	0.1457	0.4322	43.014	5	-0.421	~~1.860~~	0.0049
MWAT043R1	0.0617	0.7321	0.2356	0.0991	0.3404	42.779	5	-0.823	~~1.860~~	0.0042
* MWAT048R1	0.1461	1.7321	0.3842	0.2751	0.5331	26.130	5	2.295	~~1.860~~	0.0042
MWAT052R1	0.1401	1.6607	0.3525	0.0777	0.5417	51.546	5	0.937	~~1.860~~	0.0127
swcontrol	0.0288	0.3411	0.1263	0.0307	0.3027	105.293	5	-2.415	~~1.860~~	0.0070
MWRC210R1	0.1220	1.4464	0.3441	0.2011	0.4890	33.580	5	1.281	~~1.860~~	0.0054

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.59381	1.035	-0.2551	-0.4811
Bartlett's Test indicates equal variances (p = 0.62)	9.93906	26.217		
The control means are not significantly different (p = 0.83)	0.22609	2.30601		

Hypothesis Test (1-tail, ~~0.05~~ MJR 7-28-98

Homoscedastic t Test indicates significant differences

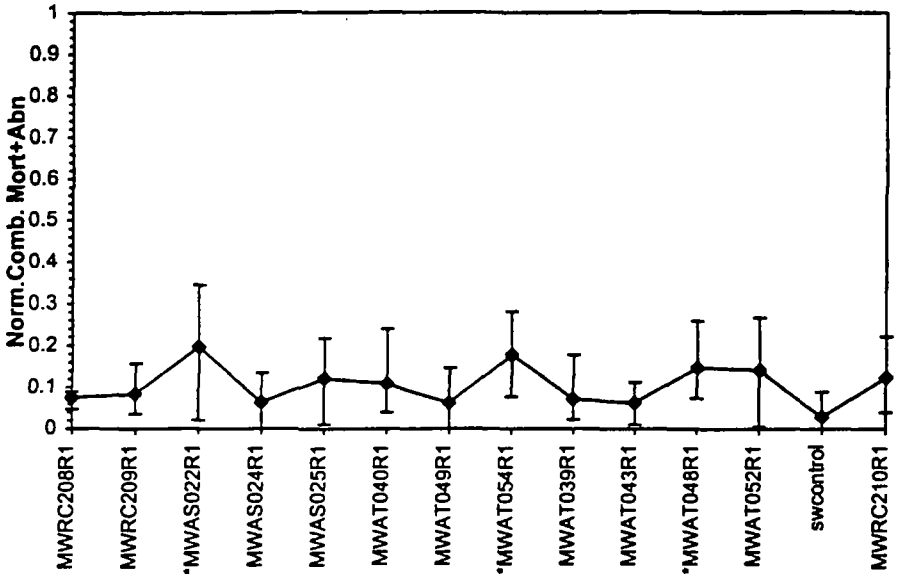
* significantly different from MWRC208R1 reference at p ≤ 0.10.

ToxCalc v5.0.15N

Larval Sediment Test-Norm.Comb. Mort+Abn

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Norm.Comb. Mort+Abn

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0474	0.0889	0.0663	0.0813	0.0889
MWRC209R1	0.0361	0.0550	0.1190	0.1566	0.0550
MWAS022R1	0.0211	0.2131	0.3449	0.1943	0.2056
MWAS024R1	0.1265	0.0173	0.0000	0.0399	0.1340
MWAS025R1	0.1604	0.1792	0.0399	0.2169	0.0098
MWAT040R1	0.2395	0.1303	0.0550	0.0776	0.0399
MWAT049R1	0.0399	0.0000	0.1453	0.0889	0.0324
MWAT054R1	0.2508	0.0776	0.1642	0.2809	0.1114
MWAT039R1	0.0587	0.0361	0.0625	0.0211	0.1755
MWAT043R1	0.0098	0.0625	0.0286	0.1114	0.0964
MWAT048R1	0.2583	0.0738	0.1529	0.1529	0.0926
MWAT052R1	0.1566	0.0060	0.1980	0.2658	0.0738
swcontrol	0.0550	0.0000	0.0000	0.0000	0.0889
MWRC210R1	0.2206	0.0399	0.1755	0.0926	0.0813

Comparison to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0745	0.8839	0.2749	0.2196	0.3027	12.889	5		for α=0.10 is 1.397 MJR 7-25-98	
MWRC209R1	0.0843	1.0000	0.2847	0.1913	0.4069	31.816	5			
*MWAS022R1	0.1958	2.3214	0.4361	0.1457	0.6277	40.465	5	1.706	~~1.860~~	0.0146
MWAS024R1	0.0636	0.7536	0.2205	0.0307	0.3748	67.490	5	-0.825	~~1.860~~	0.0113
MWAS025R1	0.1212	1.4375	0.3268	0.0991	0.4844	51.191	5	0.494	~~1.860~~	0.0135
MWAT040R1	0.1084	1.2857	0.3201	0.2011	0.5113	38.746	5	0.515	~~1.860~~	0.0088
MWAT049R1	0.0613	0.7268	0.2213	0.0307	0.3911	61.390	5	-0.868	~~1.860~~	0.0099
* MWAT054R1	0.1770	2.0982	0.4246	0.2822	0.5586	27.705	5	2.106	~~1.860~~	0.0082
MWAT039R1	0.0708	0.8393	0.2533	0.1457	0.4322	43.014	5	-0.495	~~1.860~~	0.0075
MWAT043R1	0.0617	0.7321	0.2356	0.0991	0.3404	42.779	5	-0.811	~~1.860~~	0.0068
*MWAT048R1	0.1461	1.7321	0.3842	0.2751	0.5331	26.130	5	1.644	~~1.860~~	0.0068
MWAT052R1	0.1401	1.6607	0.3525	0.0777	0.5417	51.546	5	0.746	~~1.860~~	0.0153
swcontrol	0.0288	0.3411	0.1263	0.0307	0.3027	105.293	5	-2.202	~~1.860~~	0.0096
MWRC210R1	0.1220	1.4464	0.3441	0.2011	0.4890	33.580	5	0.905	~~1.860~~	0.0080

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.693	1.035	-0.2327	-0.6117
Bartlett's Test indicates equal variances (p = 0.97)	4.49123	26.217		
The control means are not significantly different (p = 0.83)	0.22609	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MJR 7-25-98

Homoscedastic t Test indicates significant differences

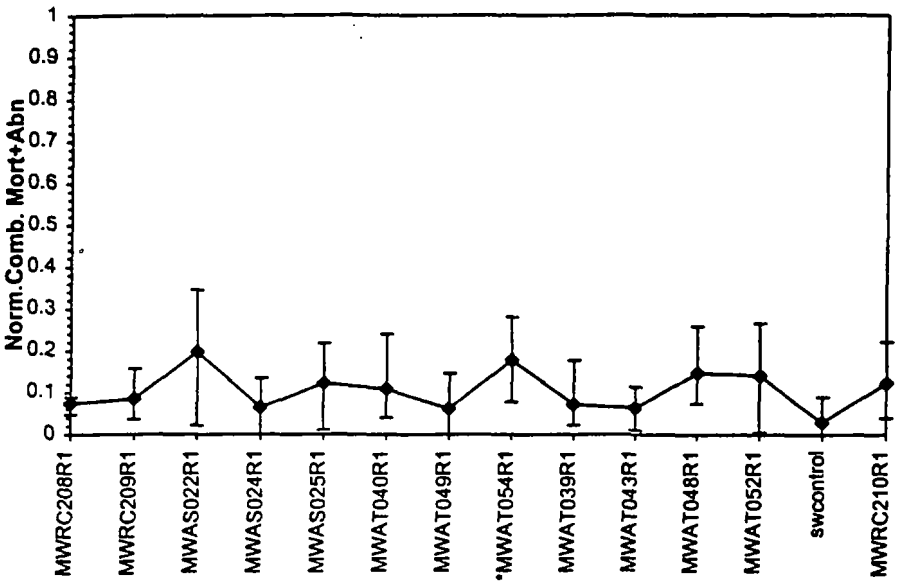
* significantly different from reference MWRC209R1 at p=0.10

ToxCalc v5.0.15N

Larval Sediment Test-Norm.Comb. Mort+Abn

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



Larval Sediment Test-Norm.Comb. Mort+Abn

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.0474	0.0889	0.0663	0.0813	0.0889
MWRC209R1	0.0361	0.0550	0.1190	0.1566	0.0550
MWAS022R1	0.0211	0.2131	0.3449	0.1943	0.2056
MWAS024R1	0.1265	0.0173	0.0000	0.0399	0.1340
MWAS025R1	0.1604	0.1792	0.0399	0.2169	0.0098
MWAT040R1	0.2395	0.1303	0.0550	0.0776	0.0399
MWAT049R1	0.0399	0.0000	0.1453	0.0889	0.0324
MWAT054R1	0.2508	0.0776	0.1642	0.2809	0.1114
MWAT039R1	0.0587	0.0361	0.0625	0.0211	0.1755
MWAT043R1	0.0098	0.0625	0.0286	0.1114	0.0964
MWAT048R1	0.2583	0.0738	0.1529	0.1529	0.0926
MWAT052R1	0.1566	0.0060	0.1980	0.2658	0.0738
swcontrol	0.0550	0.0000	0.0000	0.0000	0.0889
MWRC210R1	0.2206	0.0399	0.1755	0.0926	0.0813

Comparison to MWRC209R1

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.0745	0.8839	0.2749	0.2196	0.3027	12.889	5		for α=0.10 is 1.397 MJR 7-28-98	
MWRC209R1	0.0843	1.0000	0.2847	0.1913	0.4069	31.816	5			
*MWAS022R1	0.1958	2.3214	0.4361	0.1457	0.6277	40.465	5	1.706	~~1.860~~	0.0146
MWAS024R1	0.0636	0.7536	0.2205	0.0307	0.3748	67.490	5	-0.825	~~1.860~~	0.0113
MWAS025R1	0.1212	1.4375	0.3268	0.0991	0.4844	51.191	5	0.494	~~1.860~~	0.0135
MWAT040R1	0.1084	1.2857	0.3201	0.2011	0.5113	38.746	5	0.515	~~1.860~~	0.0088
MWAT049R1	0.0613	0.7268	0.2213	0.0307	0.3911	61.390	5	-0.868	~~1.860~~	0.0099
* MWAT054R1	0.1770	2.0982	0.4246	0.2822	0.5586	27.705	5	2.106	~~1.860~~	0.0082
MWAT039R1	0.0708	0.8393	0.2533	0.1457	0.4322	43.014	5	-0.495	~~1.860~~	0.0075
MWAT043R1	0.0617	0.7321	0.2356	0.0991	0.3404	42.779	5	-0.811	~~1.860~~	0.0068
*MWAT048R1	0.1461	1.7321	0.3842	0.2751	0.5331	26.130	5	1.644	~~1.860~~	0.0068
MWAT052R1	0.1401	1.6607	0.3525	0.0777	0.5417	51.546	5	0.746	~~1.860~~	0.0153
swcontrol	0.0288	0.3411	0.1263	0.0307	0.3027	105.293	5	-2.202	~~1.860~~	0.0096
MWRC210R1	0.1220	1.4464	0.3441	0.2011	0.4890	33.580	5	0.905	~~1.860~~	0.0080

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.01)	0.693	1.035	-0.2327	-0.6117
Bartlett's Test indicates equal variances (p = 0.97)	4.49123	26.217		
The control means are not significantly different (p = 0.83)	0.22609	2.30601		

Hypothesis Test (1-tail, ~~0.05~~) MJR 7-28-98

Homoscedastic t Test indicates significant differences

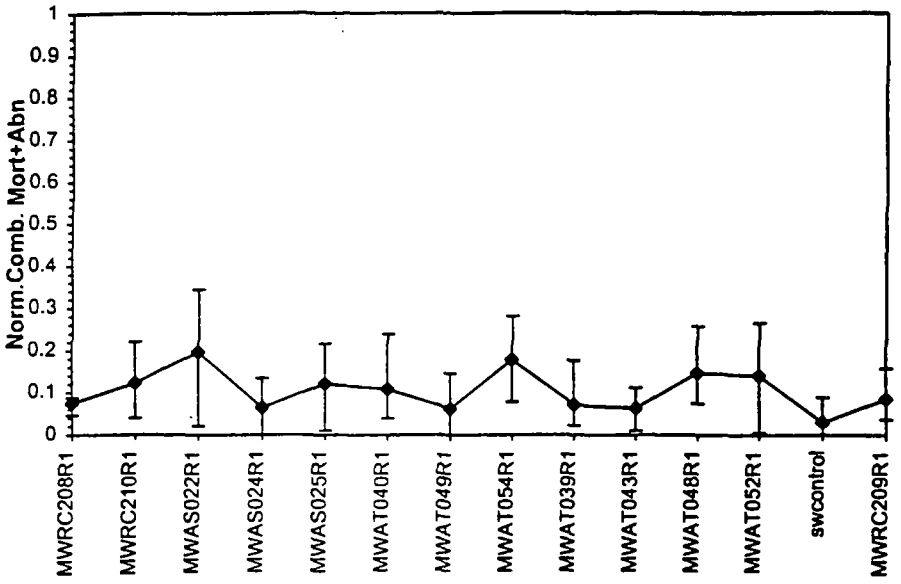
* significantly different from reference MWRC209R1 at p ≤ 0.10

ToxCalc v5.0.15N

Larval Sediment Test-Norm.Comb. Mort+Abn

Start Date:	6/4/98	Test ID:	590-3	Sample ID:	
End Date:	6/6/98	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Dose-Response Plot



ToxCalc v5.0.15N

Toxcalc data entry
J

Test: LS-Larval Sediment Test
Test ID: 590-3
Species: MG-Mytilus galloprovincialis
Protocol: PSEP 1995-Puget Sound
Sample ID:
Sample Type: SED-Sediment
Start Date: 6/4/98 End Date: 6/6/98
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	INIT	NORM	ABN	TOTAL	PMORT	PABN	PABND	TS	NS	NPM	NCMA
	1	1	MWRC208R1	322	253	14	267	0.17029	0.05243	0.2138	285	266	0.06447	0.04744
	2	2	MWRC208R1	322	242	7	249	0.22623	0.02811	0.24798	285	266	0.12754	0.08886
	3	3	MWRC208R1	322	248	18	266	0.1734	0.06767	0.22933	285	266	0.06797	0.06627
	4	4	MWRC208R1	322	244	11	255	0.20758	0.04314	0.24177	285	266	0.10652	0.08133
	5	5	MWRC208R1	322	242	11	253	0.2138	0.04348	0.24798	285	266	0.11352	0.08886
	6	1	MWRC210R1	322	207	5	212	0.34121	0.02358	0.35674	285	266	0.25718	0.22063
	7	2	MWRC210R1	322	255	20	275	0.14543	0.07273	0.20758	285	266	0.03644	0.03991
	8	3	MWRC210R1	322	219	12	231	0.28216	0.05195	0.31945	285	266	0.19061	0.17545
	9	4	MWRC210R1	322	241	12	253	0.2138	0.04743	0.25109	285	266	0.11352	0.09262
	10	5	MWRC210R1	322	244	15	259	0.19515	0.05792	0.24177	285	266	0.0925	0.08133
	11	1	MWAS022R1	322	260	29	289	0.10193	0.10035	0.19204	285	266	0	0.02108
	12	2	MWAS022R1	322	209	13	222	0.31013	0.05856	0.35053	285	266	0.22214	0.2131
	13	3	MWAS022R1	322	174	7	181	0.43754	0.03867	0.45929	285	266	0.3658	0.34488
	14	4	MWAS022R1	322	214	14	228	0.29149	0.0614	0.33499	285	266	0.20112	0.19428
	15	5	MWAS022R1	322	211	11	222	0.31013	0.04955	0.34431	285	266	0.22214	0.20557
	16	1	MWAS024R1	322	232	4	236	0.26663	0.01695	0.27906	285	266	0.17309	0.12651
	17	2	MWAS024R1	322	261	10	271	0.15786	0.0369	0.18894	285	266	0.05046	0.01732
	18	3	MWAS024R1	322	280	17	297	0.07707	0.05724	0.12989	285	266	0	0
	19	4	MWAS024R1	322	255	12	267	0.17029	0.04494	0.20758	285	266	0.06447	0.03991
	20	5	MWAS024R1	322	230	10	240	0.2542	0.04167	0.28527	285	266	0.15907	0.13404
	21	1	MWAS025R1	322	223	8	231	0.28216	0.03463	0.30702	285	266	0.19061	0.16039
	22	2	MWAS025R1	322	218	3	221	0.31324	0.01357	0.32256	285	266	0.22565	0.17922
	23	3	MWAS025R1	322	255	13	268	0.16718	0.04851	0.20758	285	266	0.06097	0.03991
	24	4	MWAS025R1	322	208	3	211	0.34431	0.01422	0.35364	285	266	0.26069	0.21687
	25	5	MWAS025R1	322	263	5	268	0.16718	0.01866	0.18272	285	266	0.06097	0.00979
	26	1	MWAT040R1	322	202	8	210	0.34742	0.0381	0.37228	285	266	0.26419	0.23946
	27	2	MWAT040R1	322	231	16	247	0.23244	0.06478	0.28216	285	266	0.13455	0.13027
	28	3	MWAT040R1	322	251	13	264	0.17961	0.04924	0.22001	285	266	0.07498	0.05497
	29	4	MWAT040R1	322	245	17	262	0.18583	0.06489	0.23866	285	266	0.08199	0.07756
	30	5	MWAT040R1	322	255	12	267	0.17029	0.04494	0.20758	285	266	0.06447	0.03991
	31	1	MWAT049R1	322	255	9	264	0.17961	0.03409	0.20758	285	266	0.07498	0.03991
	32	2	MWAT049R1	322	271	16	287	0.10814	0.05575	0.15786	285	266	0	0
	33	3	MWAT049R1	322	227	16	243	0.24487	0.06584	0.29459	285	266	0.14856	0.14533
	34	4	MWAT049R1	322	242	15	257	0.20137	0.05837	0.24798	285	266	0.09951	0.08886
	35	5	MWAT049R1	322	257	4	261	0.18894	0.01533	0.20137	285	266	0.08549	0.03238
	36	1	MWAT054R1	322	199	17	216	0.32878	0.0787	0.3816	285	266	0.24317	0.25075
	37	2	MWAT054R1	322	245	25	270	0.16097	0.09259	0.23866	285	266	0.05396	0.07756
	38	3	MWAT054R1	322	222	12	234	0.27284	0.05128	0.31013	285	266	0.1801	0.16416
	39	4	MWAT054R1	322	191	23	214	0.33499	0.10748	0.40646	285	266	0.25018	0.28087
	40	5	MWAT054R1	322	236	7	243	0.24487	0.02881	0.26663	285	266	0.14856	0.11145
	41	1	MWAT039R1	322	250	10	260	0.19204	0.03846	0.22312	285	266	0.089	0.05873
	42	2	MWAT039R1	322	256	16	272	0.15475	0.05882	0.20447	285	266	0.04695	0.03614
	43	3	MWAT039R1	322	249	8	257	0.20137	0.03113	0.22623	285	266	0.09951	0.0625
	44	4	MWAT039R1	322	260	7	267	0.17029	0.02622	0.19204	285	266	0.06447	0.02108
	45	5	MWAT039R1	322	219	15	234	0.27284	0.0641	0.31945	285	266	0.1801	0.17545
	46	1	MWAT043R1	322	263	4	267	0.17029	0.01498	0.18272	285	266	0.06447	0.00979
	47	2	MWAT043R1	322	249	16	265	0.17651	0.06038	0.22623	285	266	0.07148	0.0625
	48	3	MWAT043R1	322	258	21	279	0.133	0.07527	0.19826	285	266	0.02242	0.02861
	49	4	MWAT043R1	322	236	13	249	0.22623	0.05221	0.26663	285	266	0.12754	0.11145
	50	5	MWAT043R1	322	240	14	254	0.21069	0.05512	0.2542	285	266	0.11002	0.09639
	51	1	MWAT048R1	322	197	9	206	0.35985	0.04369	0.38782	285	266	0.27821	0.25828

ToxCalc 5.0.15N

Test: LS-Larval Sediment Test								Test ID: 590-3						
Species: MG-Mytilus galloprovincialis								Protocol: PSEP 1995-Puget Sound						
Sample ID:								Sample Type: SED-Sediment						
Start Date: 6/4/98			End Date: 6/6/98					Lab ID: ORNAS-Northwestern Aquatic Sciences						
	52	2	MWAT048R1	322	246	14	260	0.19204	0.05385	0.23555	285	266	0.089	0.0738
	53	3	MWAT048R1	322	225	19	244	0.24177	0.07787	0.30081	285	266	0.14506	0.15286
	54	4	MWAT048R1	322	225	9	234	0.27284	0.03846	0.30081	285	266	0.1801	0.15286
	55	5	MWAT048R1	322	241	22	263	0.18272	0.08365	0.25109	285	266	0.07849	0.09262
	56	1	MWAT052R1	322	224	10	234	0.27284	0.04274	0.30392	285	266	0.1801	0.15663
	57	2	MWAT052R1	322	264	12	276	0.14232	0.04348	0.17961	285	266	0.03294	0.00602
	58	3	MWAT052R1	322	213	15	228	0.29149	0.06579	0.3381	285	266	0.20112	0.19804
	59	4	MWAT052R1	322	195	3	198	0.38471	0.01515	0.39403	285	266	0.30624	0.26581
	60	5	MWAT052R1	322	246	7	253	0.2138	0.02767	0.23555	285	266	0.11352	0.0738
	61	1	swcontrol	322	251	21	272	0.15475	0.07721	0.22001	285	266	0.04695	0.05497
	62	2	swcontrol	322	272	16	288	0.10503	0.05556	0.15475	285	266	0	0
	63	3	swcontrol	322	295	30	325	0	0.09231	0.08328	285	266	0	0
	64	4	swcontrol	322	268	15	283	0.12057	0.053	0.16718	285	266	0.00841	0
	65	5	swcontrol	322	242	17	259	0.19515	0.06564	0.24798	285	266	0.0925	0.08886
	66	1	MWRC209R1	322	256	13	269	0.16408	0.04833	0.20447	285	266	0.05746	0.03614
	67	2	MWRC209R1	322	251	20	271	0.15786	0.0738	0.22001	285	266	0.05046	0.05497
	68	3	MWRC209R1	322	234	11	245	0.23866	0.0449	0.27284	285	266	0.14156	0.11898
	69	4	MWRC209R1	322	224	13	237	0.26352	0.05485	0.30392	285	266	0.16959	0.15663
	70	5	MWRC209R1	322	251	18	269	0.16408	0.06691	0.22001	285	266	0.05746	0.05497

Comments:

APPENDIX III

RAW DATA - REFERENCE TOXICANT TEST

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG/ME/MC2

BIVALVE LARVAE TEST BASED ON EPA/600/R-95/136

Test No. 999-904 Client QC TEST Investigator _____

STUDY MANAGEMENT

Client: QC TEST

Client's Study Monitor: NA

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Laboratory

Laboratory's Study Personnel:

Proj. Man./Study Dir. RS Caldwell

QA Officer L.K. Nemeth

1. S Bissa SS 2. M.S Redmond MLR

3. _____ 4. _____

Study Schedule:

Test Beginning: 6/4/98 17:30 Test Ending: 6/6/98 15:30

TEST MATERIAL

Description: Copper as $CuSO_4 \cdot 5H_2O$ ARGENT LOT # 0195 1.0 mg/mL, tox pol. 3-2-96

NAS Sample No.:				
Date of Collection:				
Date of Receipt:				
Temperature (°C):				
Conductivity (umhos/cm):				
pH:				
Hardness (mg/L):				
Alkalinity (mg/L):				
Salinity (ppt):				
Dissolved oxygen (mg/L):				
_____:				

DILUTION WATER

Source: Yaquina Bay OR

Date of Collection: 6/3/98 Salinity (ppt) 28.0 pH 7.7

Treatments: Filtered to 0.40 um, aerated

TEST ORGANISMS

Species: Mytilus galloprovincialis Date ~~Purchased~~ Collected: 6/4/98

Source: ~~Cordova Aquafarm Cordova, AK~~ Yaquina Bay

Acclimation Data:

Date	Temp (°C)	DO (mg/L)	pH	Sal. (ppt)	Comments
Adults collected on same day as spawning					
Mean					
S.D.					
(N)					

SPAWNING AND GAMETE HANDLING

Spawning: Initial 2:00 AM/PM, Final 3:50 AM/PM Fertilization 4:30 AM/PM

Number of Organisms Used: females 8 ; males 4

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG/ME/MC2

BIVALVE LARVAE TEST BASED ON EPA/600/R-95/136

Test No. 999-907 Client QC TEST Investigator _____

Egg Dilution (1 ml diluted to 100 ml):
Count/ml of dilution: 1. 123; 2. 112; 3. _____; Mean 118
DF (mean x 100/2500) = 4.72

TEST PROCEDURES AND CONDITIONS

Test concentrations: (50% series recommended) 64, 32, 16, 8, 4, 2, 1 & Ø µg/L

Test chambers: 30 mL glass vials
Test volume: 10 mL
Replicates/treatment: (4) 4
Organisms/mL (15-30) _____
Test water changes: None
Aeration during test: None
Feeding: None
Photoperiod: 16:8, L:D
Salinity: 30 ± 2 ppt
Temperature: 20 ± 1°C, oysters
Beaker placement: Stratified randomization
15 or 18 ± 1°C, mussels

Randomization chart:

A	8	4	64	Ø	16	1	2	32		
B	2	32	4	16	1	64	Ø	8		
C	Ø	2	1	8	16	64	32	4		
D	16	2	Ø	1	64	4	32	8		

PREPARATION OF TEST SOLUTIONS

This test uses a brine control _____; a salinity control _____
If a brine control is used, follow SOP# G-3 to prepare test solutions
Date of brine prep'n: _____; Brine salinity (ppt): _____
Source of Seawater: _____

$$VB = VE \frac{(TS - SE)}{(SB - TS)} = VE \frac{(\quad - \quad)}{(\quad - \quad)} = VE (\qquad)$$

In making up either a brine control or a salinity control, use salinity adjusted deionized water in place of the effluent.

Test Conc (~~µg/L~~ µg Cu)	~~Effluent~~ (~~ml/100 ml~~) µg Cu/100 mL	~~Brine~~ (ml/100 ml) 2nd W.S. (2 µg/mL)	Dilution Water (ml/100 ml)
64	6.4	32	96.8
32	3.2	1.6	98.4
16	1.6	0.8	99.2
8	0.8	0.4	~100
4	0.4	0.2	↓
2	0.2	0.1	
1	0.1	0.05	
Ø	Ø	Ø	

1st working stock (W.S.) made by 1:99 (1 mL + 100 mL) dilution of 100 µg (1 mg/mL) Cu stock, Final conc = 10 µg/mL Cu
2nd W.S. made by 20:80 (20 mL + 100 mL) dilution of 1st W.S. Final conc = 2 µg/mL Cu

1/97

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-CG/ME/MC2

BIVALVE LARVAE TEST BASED ON EPA/600/R-95/136

Test No. 919-904 Client QC TEST Investigator

WATER QUALITY DATA

Conc. (µg/L)	0-Hour Temp. (°C)	0-Hour DO (mg/L)	0-Hour Sal. (ppt)	0-Hour pH	48-Hour BC Temp. (°C)	48-Hour BC DO (mg/L)	48-Hour BC Sal. (ppt)	48-Hour BC pH
64	15.8	7.6	27.0	8.0	14.8	8.0	29.0	8.0
32	15.8	7.6	27.0	8.0	14.8	8.0	29.0	8.0
16	15.8	7.6	27.0	8.0	14.8	8.0	27.0	8.0
8	15.8	7.7	27.0	8.0	14.8	8.0	25.5	8.0
4	15.8	7.8	27.0	8.0	14.8	8.0	25.5	8.0
2	15.8	7.7	27.0	8.0	14.8	8.0	25.0	8.0
1	15.8	7.6	27.0	7.9	14.8	8.0	25.5	8.0
Control	15.8	7.6	27.0	7.9	14.8	8.0	25.0	8.0
Brine Cont.	—	—	—	—	—	—	—	—

WATER QUALITY:	Mean	S.D.	N
Temperature (°C):	15.3	0.5	16
DO (mg/L):	7.8	0.2	16
Salinity (ppt):	27.5	0.9	16
pH:	8.0	0.0	16

WATER BATH TEMPERATURE (°C):

Day 0:	15.7	Day 0:	15.8
Day 1:	15.0	Day 1:	[illegible]
Day 2:	15.0	Day 2:	14.8

LARVAL COUNT DATA

Conc. (µg/L)	Replicate 1 N	Replicate 1 A	Replicate 2 N	Replicate 2 A	Replicate 3 N	Replicate 3 A	Replicate 4 N	Replicate 4 A
1.								
2.								
3.								
4. 64	0	[illegible]	0	[illegible]	0	[illegible]	0	261
5. 32	0	[illegible]	0	[illegible]	0	[illegible]	0	287
6. 16	[illegible]	[illegible]	1	[illegible]	4	[illegible]	[illegible]	[illegible]
7. 8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8. 4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9. 2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10. 1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Control	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brine								
Zero time	[illegible]		[illegible]		[illegible]		[illegible]	

$\bar{X}$ = 308

Remarks:

Bivalve Larval Survival and Development Test-Proportion Alive

Start Date:	6/4/98 17:00	Test ID:	999-904	Sample ID:	~~REF-Ref~~ Toxicant
End Date:	6/6/98 15:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	CUSO-Copper sulfate
Sample Date:		*Protocol:*	*EPAW 95-EPA West Coast*	*Test Species:*	*MG-Mytilus galloprovincialis*
Comments:					

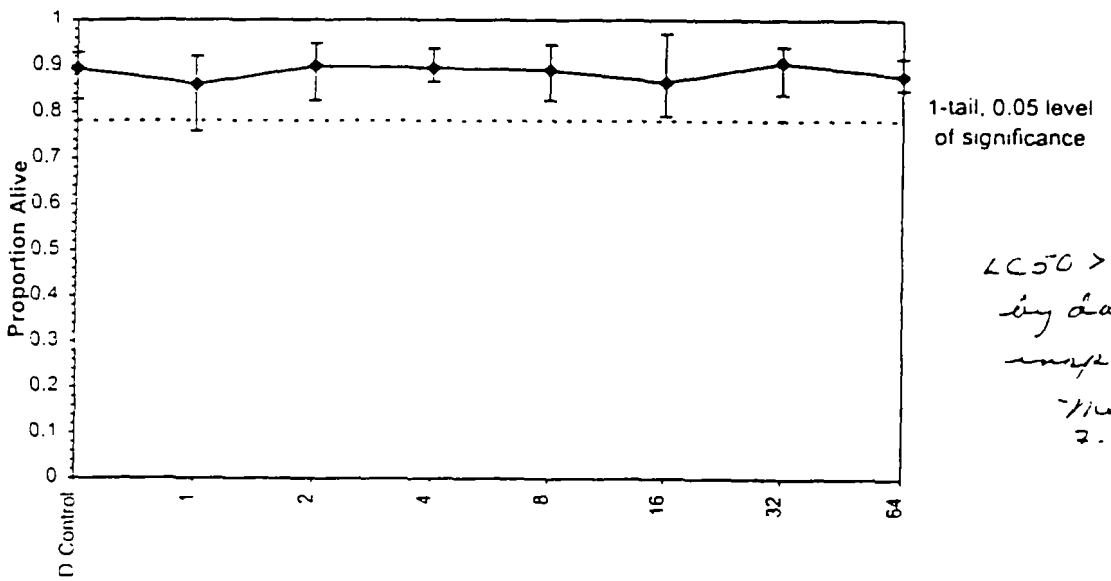
Conc-ug/L	1	2	3	4
D-Control	0.9091	0.9286	0.9091	0.8279
1	0.7597	0.8961	0.8636	0.9221
2	0.8247	0.9481	0.9188	0.9026
4	0.9383	0.8734	0.9026	0.8669
8	0.8247	0.9383	0.9448	0.8506
16	0.9708	0.7922	0.8896	0.8052
32	0.9156	0.9416	0.8377	0.9318
64	0.8474	0.8929	0.9156	0.8474

			Transform: Arcsin Square Root						1-Tailed			
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD		
D-Control	0.8937	1.0000	1.2431	1.1430	1.3002	5.533	4				131	123[illegible]
1	0.8604	0.9628	1.1954	1.0585	1.2879	8.299	4	0.761	2.480	0.1554	172	1232
2	0.8985	1.0054	1.2537	1.1388	1.3409	6.768	4	-0.170	2.480	0.1554	125	1232
4	0.8953	1.0018	1.2444	1.1973	1.3198	4.494	4	-0.021	2.480	0.1554	129	1232
8	0.8896	0.9955	1.2416	1.1388	1.3336	8.018	4	0.024	2.480	0.1554	136	1232
16	0.8644	0.9673	1.2106	1.0975	1.3990	11.501	4	0.519	2.480	0.1554	167	1232
32	0.9067	1.0145	1.2663	1.1561	1.3266	6.032	4	-0.371	2.480	0.1554	115	1232
64	0.8758	0.9800	1.2131	1.1695	1.2760	4.349	4	0.479	2.480	0.1554	153	1232

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.95546	0.904	0.01672	-0.3954
Bartlett's Test indicates equal variances (p = 0.78)	3.96048	18.4753		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	64	>64			0.11218	0.12515	0.00238	0.00785	0.94578	7, 24

Dose-Response Plot



LC50 > 64 ug/L,
by data
inspection
[illegible]
7-22-98

ToxCalc v5.0.15N

Bivalve Larval Survival and Development Test-Proportion Normal

Start Date:	6/4/98 17:00	Test ID:	999-904	Sample ID:	REF-Ref Toxicant
End Date:	6/6/98 15:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	CUSO-Copper sulfate
Sample Date:		Protocol:	EPAW 95-EPA West Coast	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-ug/L	1	2	3	4
D-Control	0.8312	0.8831	0.8474	0.7890
1	0.7208	0.8571	0.7955	0.8766
2	0.7370	0.8701	0.8474	0.8247
4	0.8312	0.7727	0.8474	0.7760
8	0.7630	0.8149	0.8961	0.7695
16	0.0162	0.0032	0.0130	0.0097
32	0.0000	0.0000	0.0000	0.0000
64	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
D-Control	0.8377	1.0000	1.1581	1.0935	1.2219	4.593	4				200	1232
1	0.8125	0.9700	1.1277	1.0141	1.2119	7.893	4	0.648	2.410	0.1130	231	1232
2	0.8198	0.9787	1.1357	1.0323	1.2021	6.480	4	0.477	2.410	0.1130	222	1232
4	0.8068	0.9632	1.1171	1.0739	1.1695	4.348	4	0.873	2.410	0.1130	238	1232
8	0.8109	0.9680	1.1253	1.0623	1.2426	7.397	4	0.699	2.410	0.1130	233	1232
*16	0.0106	0.0126	0.0995	0.0570	0.1278	30.830	4	22.571	2.410	0.1130	1219	1232
32	0.0000	0.0000	0.0285	0.0285	0.0285	0.000	4				1232	1232
64	0.0000	0.0000	0.0285	0.0285	0.0285	0.000	4				1232	1232

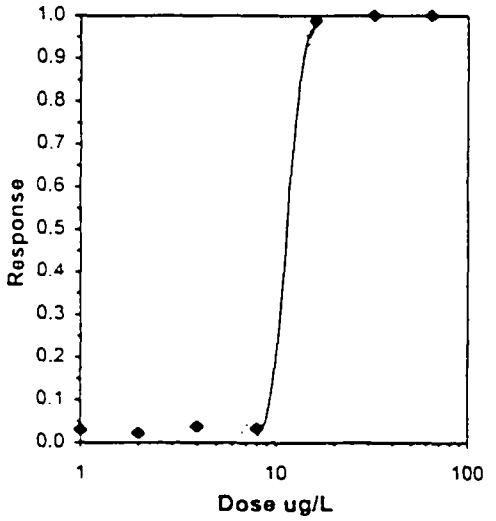
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.98569	0.884	-0.0748	-0.4409
Bartlett's Test indicates equal variances (p = 0.61)	3.60476	15.0863		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	8	16	11.3137		0.09098	0.10843	0.71258	0.0044	2.6E-14	5, 18

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	15.1159	1.89203	11.4075	18.8243	0.16234	1.66054	15.0863	0.89	1.05661	0.06616	8
Intercept	-10.972	2.25615	-15.394	-6.5495							
TSCR	0.1808	0.00548	0.17006	0.19155							

Point	Probits	ug/L	95% Fiducial Limits	
EC01	2.674	7.99293	6.40755	9.14957
EC05	3.355	8.86729	7.34854	9.95028
EC10	3.718	9.37185	7.90475	10.4063
EC15	3.964	9.7284	8.30323	10.7262
EC20	4.158	10.0214	8.63392	10.9878
EC25	4.326	10.2798	8.92784	11.2177
EC40	4.747	10.9609	9.71213	11.8202
EC50	5.000	11.3922	10.2153	12.1999
EC60	5.253	11.8404	10.7429	12.5937
EC75	5.674	12.6249	11.6747	13.2837
EC80	5.842	12.9505	12.0633	13.5715
EC85	6.036	13.3405	12.5289	13.919
EC90	6.282	13.8481	13.1318	14.3782
EC95	6.645	14.636	14.0487	15.1196
EC99	7.326	16.2371	15.7338	16.8379



Bivalve Larval Survival and Development Test-Proportion Normal

Start Date:	6/4/98 17:00	Test ID:	999-904	Sample ID:	REF-Ref Toxicant
End Date:	6/6/98 15:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	CUSO-Copper sulfate
Sample Date:		Protocol:	EPAW 95-EPA West Coast	Test Species:	MG-Mytilus galloprovincialis
Comments:					

Conc-ug/L	1	2	3	4
D-Control	0.8312	0.8831	0.8474	0.7890
1	0.7208	0.8571	0.7955	0.8766
2	0.7370	0.8701	0.8474	0.8247
4	0.8312	0.7727	0.8474	0.7760
8	0.7630	0.8149	0.8961	0.7695
16	0.0162	0.0032	0.0130	0.0097
32	0.0000	0.0000	0.0000	0.0000
64	0.0000	0.0000	0.0000	0.0000

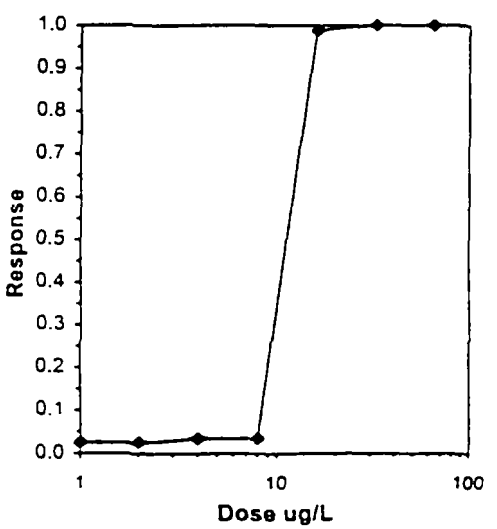
			Transform: Arcsin Square Root						1-Tailed		Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
D-Control	0.8377	1.0000	1.1581	1.0935	1.2219	4.593	4				0.8377	1.0000
1	0.8125	0.9700	1.1277	1.0141	1.2119	7.893	4	0.648	2.410	0.1130	0.8162	0.9743
2	0.8198	0.9787	1.1357	1.0323	1.2021	6.480	4	0.477	2.410	0.1130	0.8162	0.9743
4	0.8068	0.9632	1.1171	1.0739	1.1695	4.348	4	0.873	2.410	0.1130	0.8088	0.9656
8	0.8109	0.9680	1.1253	1.0623	1.2426	7.397	4	0.699	2.410	0.1130	0.8088	0.9656
*16	0.0106	0.0126	0.0995	0.0570	0.1278	30.830	4	22.571	2.410	0.1130	0.0106	0.0126
32	0.0000	0.0000	0.0285	0.0285	0.0285	0.000	4				0.0000	0.0000
64	0.0000	0.0000	0.0285	0.0285	0.0285	0.000	4				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.98569	0.884	-0.0748	-0.4409
Bartlett's Test indicates equal variances (p = 0.61)	3.60476	15.0863		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	8	16	11.3137		0.09098	0.10843	0.71258	0.0044	2.6E-14	5, 18

Linear Interpolation (80 Resamples)

Point	ug/L	SD	95% CL(Exp)		Skew
IC05	8.131	2.738	0.000	8.546	-0.8706
IC10	8.551	0.445	6.878	8.939	-5.3604
IC15	8.970	0.203	8.105	9.333	-0.4433
IC20	9.390	0.191	8.578	9.732	-0.4425
IC25	9.810	0.179	9.052	10.131	-0.4414
IC40	11.069	0.143	10.472	11.327	-0.4366
IC50	11.908	0.119	11.419	12.125	-0.4309

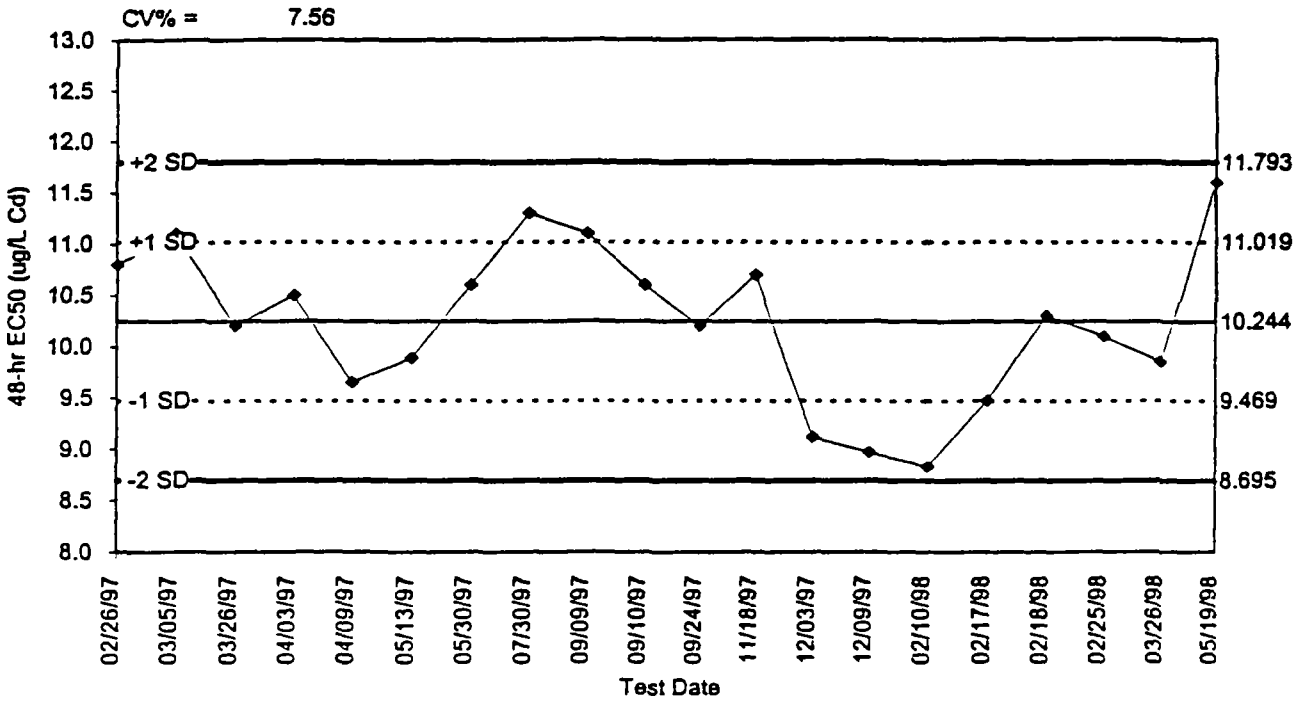


ToxCalc v5.0.15N

Test: BV-Bivalve Larval Survival and Development Test						Test ID: 999-904		
Species: MG-Mytilus galloprovincialis						Protocol: EPAW 95-EPA West Coast		
Sample ID: REF-Ref Toxicant						Sample Type: CUSO-Copper sulfate		
Start Date: 6/4/98 17:00				End Date: 6/6/98 15:00		Lab ID: ORNAS-Northwestern Aquatic Sciences		
Pos	ID	Rep	Group	Initial Density	Final Density	Total Counted	Number Normal	Notes
	1	1	D-Control	308	280	308	256	
	2	2	D-Control	308	286	308	272	
	3	3	D-Control	308	280	308	261	
	4	4	D-Control	308	255	308	243	
	5	1	1.000	308	234	308	222	
	6	2	1.000	308	276	308	264	
	7	3	1.000	308	266	308	245	
	8	4	1.000	308	284	308	270	
	9	1	2.000	308	254	308	227	
	10	2	2.000	308	292	308	268	
	11	3	2.000	308	283	308	261	
	12	4	2.000	308	278	308	254	
	13	1	4.000	308	289	308	256	
	14	2	4.000	308	269	308	238	
	15	3	4.000	308	278	308	261	
	16	4	4.000	308	267	308	239	
	17	1	8.000	308	254	308	235	
	18	2	8.000	308	289	308	251	
	19	3	8.000	308	291	308	276	
	20	4	8.000	308	262	308	237	
	21	1	16.000	308	299	308	5	
	22	2	16.000	308	244	308	1	
	23	3	16.000	308	274	308	4	
	24	4	16.000	308	248	308	3	
	25	1	32.000	308	282	308	0	
	26	2	32.000	308	290	308	0	
	27	3	32.000	308	258	308	0	
	28	4	32.000	308	287	308	0	
	29	1	64.000	308	261	308	0	
	30	2	64.000	308	275	308	0	
	31	3	64.000	308	282	308	0	
	32	4	64.000	308	261	308	0	

Comments:

Mytilus galloprovincialis control chart - EC50, last 20 points



msk
7-9-98

ToxCalc v4.0
- 8 -

TOXICITY TEST NO. 590-4

TOXICITY TEST REPORT

TEST IDENTIFICATION

Test No.: 590-4
Title: Juvenile *Neanthes* 20-day sediment toxicity test.
Protocol: NAS-XXX-NA4, July 23, 1996. Revised October 31, 1997. Complies with: Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP 1995), with modifications as specified by the Puget Sound Dredged Disposal Analysis Program (PSDDA, now Dredged Material Management Program or DMMP).

STUDY MANAGEMENT

Study Sponsor: Foster Wheeler Environmental, 10900 N.E. 8th St., Suite 1300, Bellevue, WA 98004
Sponsor's Study Monitor: Mr. Gary Braun
Testing Laboratory: Northwestern Aquatic Sciences, P.O. Box 1437, Newport, Oregon 97365.
Test Location: Newport Laboratory.
Laboratory's Study Personnel: R.S. Caldwell, Ph.D., Proj. Mngr./Study Dir.; L.K. Nemeth, B.A., QA Officer; G.A. Buhler, B.S., Aq. Toxicol.; G.J. Irissarri, Aq. Toxicol.; M.S. Redmond, M.S., Aq. Toxicol.; E. Coffey, B.S., Sr. Tech; B. Moran, M.S., Tech.; S. Bione, B.S., Tech.
Study Schedule:
Test Beginning: 7-3-98, 1600 hrs.
Test Ending: 7-23-98, 1400 hrs.
Disposition of Study Records: All specimens, raw data, reports and other study records are stored according to Good Laboratory Practice regulations at Northwestern Aquatic Sciences, 3814 Yaquina Bay Rd., Newport, OR 97365.
Good Laboratory Practices: The test was conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).
Statement of Quality Assurance: The test data were reviewed by the Quality Assurance Unit to assure that the study was performed in accordance with the protocol and standard operating procedures. This report is an accurate reflection of the raw data.

TEST MATERIAL

Control Sediment: The control sediment was collected by NAS, from Yaquina Bay, near the *Rhepoxynius* collection site on 7-1-98. It was sieved through a 1.0 mm screen and homogenized. Stored at 4°C in the dark until used in the test.
Test Sediments: Unidentified marine sediments. Details are as follows:

NAS Sample No.	0690F	0691F	0692F	0721F
Foster Wheeler Sample No.	MWAS022R1	MWAS024R1	MWAS025R1	MWAT040R1
Collection Date	5-15-98	5-15-98	5-15-98	5-18-98
Receipt Date	5-18-98	5-18-98	5-18-98	5-20-98
Interstitial salinity (ppt)	28.5	27.0	28.0	27.0

NAS Sample No.	0749F	0750F
Foster Wheeler Sample No.	MWRC208R1	MWRC209R1
Collection Date	5-22-98	5-22-98
Receipt Date	5-28-98	5-28-98
Interstitial salinity (ppt)	28.0	29.0

Storage: Stored locked at 4°C in the dark in capped containers until used.
Treatments: Homogenized.

TEST WATER

Source: Yaquina Bay, Oregon
Dates of Collection: 7-2-98
Water Quality: Salinity 28.0 ppt; pH 7.7
Pretreatment: Filtered to ≤0.40 µm, salinity adjusted with MilliQ® deionized water, and aerated.

TEST ORGANISMS

Species: *Neanthes* sp., marine polychaete worm
Age: 2-3 week post-emergence juveniles.
Initial wt.: 0.18 mg
Source: Laboratory cultures at the Department of Biology, California State University, Long Beach, California. Worms were received on 7-1-98.
Acclimation: Conditions during acclimation averaged: temperature, 20.3 ± 0.7°C; salinity 31.5 ± 2.2 ppt; dissolved oxygen 6.2 ± 0.7 mg/L; pH 7.7 ± 0.2; photoperiod 16:8 hr, L:D.

TEST PROCEDURES AND CONDITIONS

The following is an abbreviated statement of the test procedures and a statement of the test conditions actually employed. See the test protocol (Appendix I) for a more detailed description of the test procedures used in this study.

Test Chambers: 1 L covered borosilicate glass beakers.
Test Volumes: 175 ml of test or control sediment; 950 ml total volume.
Replicates/Treatment: 5 (plus one water quality replicate, and two sacrificial replicates for day 0 and day 10 interstitial ammonia and sulfide measurements)
Sediment Salinity Adjustment: None required.
Organisms/Treatment: 25 (5/replicate)
Water Volume Changes: One third of the seawater in each beaker was replaced every third day.
Aeration: Provided using a 1 ml glass pipette with the tip approximately 3-4 cm below the water surface. Air was bubbled at a low rate (150-300 ml/min) so as not to disturb the sediment surface.
Feeding: Animals were fed 40 mg TetraMarin per beaker every other day.
Acceptance Criteria: DMMP and Sediment Management Standards (SMS) require control sediment mortality of ≤10%, and a target growth rate of >0.72 mg/day. DMMP requires a growth rate of >0.38 mg/day. For both programs, reference sediment mortality should be ≤20% with a growth rate of ≥80% that of the control sediment.
Effects Criteria: 1) survival after 20 days, 2) average individual biomass, and 3) average individual growth rate. Death is defined as no visible appendage movement or response to tactile stimulation. Missing worms are considered to be dead.
Water Quality and Other Test Conditions: Ammonia-N and sulfide were measured in the pore water of the bulk test sediments upon receipt, and in the interstitial water of one replicate sacrificial beaker on day 0. Ammonia-N was measured in the interstitial water of additional replicate sacrificial beakers on days 11 and 20. Pore water was obtained by centrifugation. Ammonia-N was measured in the overlying water of one replicate beaker on test days 0, 3, 6, 9, 12, 15, 18, and 20. The temperature, dissolved oxygen, salinity, and pH were measured in all beakers except day 0 and 10 sacrificial beakers on test days 0 and 20, and in one replicate beaker on test days 3, 6, 9, 12, 15, and 18 prior to test solution renewal. Sulfide and ammonia-N analyses were by the methylene blue (EPA Method 376.2) and salicylate (Clin. Chim. Acta 14:403, 1996) colorimetric methods, respectively; samples were not distilled prior to analysis. The values of individual water quality measurements are to be found in the raw data (Appendix II). The means, and minimum and maximum values for the water quality parameters during the test are listed in Table 1. The photoperiod was constant light.

DATA ANALYSIS METHODS

Percent survival, individual biomass, and individual growth rate at the end of the test were determined from the final observations according to the formulas:

Percent survival = 100 x (no. of surviving worms/initial number of worms)
Individual biomass = total dry wt. of worms/number of surviving worms weighed

Individual growth rate = (individual biomass - the initial dry wt.)/the number of test days

Means and standard deviations for the biological endpoints described above and for water quality data were computed using Microsoft Excel Ver.5.0.

Values of the three endpoints (survival, individual biomass, and individual growth rate) for the test sediments were statistically compared against each of the two reference sediments using ToxCalc v5.0.15N. An arcsine square root transformation was performed on proportional data before analysis. Following transformation and determination of normality and homogeneity of variances, one-tailed homoscedastic or heteroscedastic t-tests, or Wilcoxon Two-Sample tests, were conducted at the 0.05 level of significance.

PROTOCOL DEVIATIONS

The initial average worm weight was 0.18 mg dry weight, which is lower than the 0.5 to 1.0 mg that PSEP suggests indicates 2-3 week post-emergence juvenile worms. Worms were ordered from the only available supplier and specified to be 2-3 week post emergence on receipt. Worms were acclimated in the laboratory for two days prior to test initiation and no mortality or problems were observed during acclimation. Calculation of growth rate for controls indicated 0.68 mg/day which indicates that worms were in a rapid growth phase during testing which is the intent of using 2-3 week post-emergence animals.

REFERENCE TOXICANT TEST

The reference toxicant test is a standard multi-concentration toxicity test using cadmium as $CdCl_2 \bullet 2\frac{1}{2}H_2O$, to evaluate the performance of the test organisms used in the sediment toxicity test. The performance is evaluated by comparing the results of this test with historical results obtained at the laboratory. The reference toxicant test raw data are found in Appendix III.

Test No.: 999-918
Reference Toxicant and Source: $CdCl_2 \bullet 2\frac{1}{2}H_2O$, Mallinckrodt, Lot No. TNZ, 1.0 mg/ml stock prepared 6-23-98.
Test Date: 7-3-98
Dilution Water Used: Yaquina Bay, Oregon, seawater
Result: 96-hr LC50, 7.6 mg/L Cd. This result is within the laboratory's control chart warning limits (2.37 - 14.0 mg/L).

RESULTS AND CONCLUSIONS

Water quality data are summarized in Table 1. A detailed tabulation of the water quality results by sample and test day can be found in Appendix II. The means and standard deviations of percent survival, individual biomass as dry weight, and individual growth rate of *Neanthes* exposed for 20 days to sediments are summarized in Table 2. Detailed data organized by sample and replicate, including the initial observations on survival and worm final and tare weights, and summary statistics for these observations, are given in Appendix II, as well as data on the estimated initial weight of worms at the beginning of the test. Table 3 gives the final interstitial salinities in the sediments of each water quality replicate. Tables 4 and 5 summarize the interstitial ammonia-N and sulfide concentrations in the sediments of each sacrificial beaker on days 0, 11, and 20.

All water quality observations of overlying water temperature, dissolved oxygen, salinity, and pH were within the protocol specified ranges. No sulfides were detected in the overlying water either at the beginning or end of the test. Ammonia-N in the overlying water ranged from 0.2 to 8.0 mg/L.

The test met the acceptability criterion (≥90%) for control survival; mean survival in the control was 92.0%. The individual growth rate in the controls averaged 0.68 mg/day. This is slightly below the DMMP/SMS recommendation of 0.72 mg/day, but above the 0.38 mg/day DMMP QA/QC failure criterion for *Neanthes*. Although initial worm weight was low (0.18 mg), survival and growth rate in the controls were acceptable, and the reference toxicant (positive control) result was within the control chart limits for this species. Therefore this test is considered acceptable.

Survival in both reference sediments met the acceptability criterion of ≥80%. Survival in MWRC208R1 was 100.0%, and that in MWRC209R1 was 96.0%. MWRC208R1 also met the growth rate acceptance criterion of ≥80% of the control growth rate, with a growth rate of 0.56 mg/day (82.3% of the control growth rate). The growth rate in MWRC209R1, however, 0.44 mg/day, was only 64.7% of the control growth rate.

Survival in test sediments was not significantly different from that in either reference sediment. Average individual worm biomass and individual growth rate were significantly less than that in reference MWRC208R1 in MWAS025R1 and MWAT040R1, but significantly less than that in reference MWRC209R1 only for MWAS025R1.

STUDY APPROVAL

Michele S. Redmond for
Richard S. Caldwell 8-17-98
Project Manager/Study Director Date

Julie R. Fiire 8-17-98
Quality Assurance Unit Date

Michele S. Redmond for
Richard S. Caldwell 8-17-98
Manager, Toxicology Date

Table 1. Summary of water quality conditions prevailing during the *Neanthes* 20-day test.

Water Quality Parameter	Mean ± SD	Minimum	Maximum	N
Temperature (°C)	20.4 ± 0.2	20.0	20.7	126
Dissolved Oxygen (mg/L)	6.8 ± 0.3	5.9	7.2	126
Salinity (ppt)	28.5 ± 0.6	27.0	30.0	126
pH	8.1 ± 0.2	7.7	8.6	126
Total Sulfide (mg/L)	---	<0.02	<0.02	14
Total Ammonia-N (mg/L)	---	0.2	8.0	55

Table 2. Means and standard deviations (n=5) of percent survival, individual dry weight, and individual growth rate of *Neanthes* exposed for 20 days to marine sediments.

Sample Description	Percent Survival (20-days)	Individual dry wt. (mg)		Individual growth rate (mg/day)	
Control (NAS # 1024F)	92.0 ± 11.0	13.9 ± 2.9		0.68 ± 0.14	
MWAS022R1 (NAS # 0690F)	84.0 ± 26.1	12.6 ± 2.2		0.62 ± 0.11	
MWAS024R1 (NAS # 0691F)	96.0 ± 8.9	9.5 ± 2.1		0.47 ± 0.10	
MWAS025R1 (NAS # 0692F)	100.0 ± 0.0	6.5 ± 1.4	ab	0.32 ± 0.07	ab
MWAT040R1 (NAS # 0721F)	100.0 ± 0.0	8.7 ± 0.7	a	0.43 ± 0.04	a
MWRC208R1 (NAS # 0749F)	100.0 ± 0.0	11.4 ± 2.3		0.56 ± 0.11	
MWRC209R1 (NAS # 0750F)	96.0 ± 8.9	8.9 ± 2.3		0.44 ± 0.11	

[a] Significantly different ($p \leq 0.05$) from reference sediment MWRC208R1.
[b] Significantly different ($p \leq 0.05$) from reference sediment MWRC209R1.

Table 3. Means and standard deviations (n=5) of final sediment interstitial salinity for sediments tested for 20 days with the polychaete worm *Neanthes*.

Sample Description	Salinity (ppt)
Control (NAS # 1024F)	27.9 ± 0.2
MWAS022R1 (NAS # 0690F)	28.0 ± 0.0
MWAS024R1 (NAS # 0691F)	28.0 ± 0.0
MWAS025R1 (NAS # 0692F)	28.0 ± 0.0
MWAT040R1 (NAS # 0721F)	27.7 ± 0.3
MWRC208R1 (NAS # 0749F)	27.8 ± 0.3
MWRC209R1 (NAS # 0750F)	27.8 ± 0.3

Table 4. Sediment interstitial ammonia-N for sediments tested for 20 days with the polychaete *Neanthes*.

Sample Description	Ammonia-N in mg/L		
	day 0	day 11	day 20
Control (NAS # 1024F)	*	*	*
MWAS022R1 (NAS # 0690F)	7.5	22.5	6.5
MWAS024R1 (NAS # 0691F)	12.2	15.0	2.0
MWAS025R1 (NAS # 0692F)	13.5	11.5	5.5
MWAT040R1 (NAS # 0721F)	10.0	12.2	4.8
MWRC208R1 (NAS # 0749F)	12.5	30.0	4.0
MWRC209R1 (NAS # 0750F)	37.5	15.0	5.2

* not enough sample for analysis.

Table 5. Sediment interstitial sulfide for sediments tested for 20 days with the polychaete *Neanthes*.

Sample Description	Sulfide in mg/L day 0
control (NAS #1024F)	*
MWAS022R1 (NAS #0690F)	<0.5
MWAS024R1 (NAS #0691F)	<0.5
MWAS025R1 (NAS #0692F)	<0.5
MWAT040R1 (NAS #0721F)	<0.5
MWRC208R1 (NAS #0749F)	<0.5
MWRC209R1 (NAS #0750F)	<0.5

* not enough sample for analysis

APPENDIX I

PROTOCOL

TEST PROTOCOL

JUVENILE POLYCHAETE, NEANTHES SP., 20-DAY SOLID PHASE SEDIMENT BIOASSAY

1. INTRODUCTION

1.1 Purpose of Study: The purpose of this study is to characterize the toxicity of marine sediments based on worm survival and growth.

1.2 Summary of Method: The 20-day static renewal test is performed using laboratory-cultured, 2-3 week post-emergence juvenile Neanthes sp. purchased from a supplier. Test sediments are placed in the bottom of 1 liter glass beakers used as test vessels which are then filled with clean seawater. Five replicate containers for each test sediment, a reference site sediment, and a control sediment are employed. Each replicate contains five worms. During test setup, three subsamples of five worms each are randomly selected to provide an estimate of initial biomass. During the exposure period, each chamber is provided with 40 mg of food on an every-other-day basis. Every third day, one-third of the seawater in each chamber is exchanged with fresh seawater. Mortality and growth are the response criteria used. The mean and standard deviation for each treatment and test endpoint are given in the final report. Between-treatment comparisons may be made using Student's t-test, Wilcoxon's Two-Sample test, or Mann-Whitney U test, where each treatment is compared to the control or the reference sediment.

2. STUDY MANAGEMENT

2.1 Sponsor's Name and Address:

_____
_____
_____
_____

2.2 Sponsor's Study Monitor:

_____

2.3 Name of Testing Laboratory:
Northwestern Aquatic Sciences
Yaquina Bay Road P.O. Box 1437
Newport, OR 97365.

2.4 Test Location: _____

2.5 Laboratory's Personnel to be Assigned to the Study:
Study Director: _____
Quality Assurance Officer: _____
Aquatic Biologist: _____
Aquatic Biologist: _____

2.6 Proposed Testing Schedule: Tests are to begin within 14 days of sample collection. Reference toxicant test to be run concurrently. (Test sediments may be held under nitrogen for up to eight weeks for PSDDA and COE work.)

2.7 Good Laboratory Practices: The test is conducted following the principles of Good Laboratory Practices (GLP) as defined in the EPA/TSCA Good Laboratory Practice regulations revised August 17, 1989 (40 CFR Part 792).

3. TEST MATERIAL

The test materials are marine sediments. The control, reference, and test sediments are placed in solvent cleaned 1 L glass jars fitted with PTFE-lined screw caps. At the laboratory the samples are stored at 4°C in the dark. The original sealed containers may be stored for up to 14 days prior to testing. A negative control sediment is collected from a clean site. In addition, a reference sediment, a clean sediment with physical characteristics similar to the test sediments, may be employed as a control.

4. TEST WATER

Test water is filtered Yaquina Bay seawater adjusted to a salinity of 28 ppt. The water is pumped daily from Yaquina Bay into a 6000 gal seasoned fiberglass reservoir from which it is supplied under pump pressure to the laboratory. Filtration is accomplished using a sand filter followed by a medium porosity (10-25 µm) cartridge filter. A fine (0.45 µm) cartridge filter is then used. An alternative seawater supply of similar quality may be used.

5. TEST ORGANISMS

5.1 Species: Neanthes sp.

5.2. Source: Neanthes are obtained from laboratory cultures. California State University, Long Beach, Dept. of Biology is a source for purchasing these worms.

5.3. Laboratory Handling: Worms are received from the supplier in plastic bags containing seawater and algae (Enteromorpha). Upon receipt, water quality data are taken on 1 or 2 bags and all bags with worms are then placed in holding aquaria containing seawater at 20 ± 1°C, and the salinity is adjusted to 28 ± 2 ppt. The worms are released from the bags after temperature equilibration. Worms are maintained for 1-2 days prior to use in tests. Gentle aeration is supplied to the holding aquaria. During the holding period, organisms are fed TetraMarin_ (8 mg per juvenile worm) on an every-other-day basis. If the food is not being consumed, feeding should be reduced. No water changes are required if holding time is less than 1 week.

5.4 Age at Study Initiation: 2-3 week post-emergence juveniles (0.5-1.0 mg dry weight).

6. DESCRIPTION OF TEST SYSTEM

6.1 Test Chambers and Environmental Control: Test chambers used in the toxicity test are 1000 ml glass beakers. The beakers are covered with lids to minimize contamination and evaporation of seawater or loss of volatile compounds. Test chambers are maintained at constant temperature by partial immersion in a temperature-controlled water bath or by placement in a temperature-controlled room. Minimal aeration is supplied through a glass pipet with the tip placed 3-4 cm below the water surface. The aeration rate should be 150 - 300 mL/minute or approximately 100 bubbles per minute). The test is performed under continuous illumination, using ambient laboratory lighting.

6.2 Cleaning: All laboratory glassware, including test chambers, is cleaned as described in EPA/600/4-90/027. New glassware and test systems are soaked 15 minutes in tap water and scrubbed with detergent (or cleaned in automatic dishwasher); rinsed twice with tap water; carefully rinsed once with fresh, dilute (10%, V:V) hydrochloric or nitric acid to remove scale, metals, and bases; rinsed twice with deionized water; rinsed once with acetone to remove organic compounds (using a fume hood or canopy); and rinsed three times with deionized water. Test systems and chambers are rinsed again with dilution water just before use.

7. EXPERIMENTAL DESIGN AND TEST PROCEDURES

7.1 Experimental Design: The experimental design consists of exposure of test organisms to a number of test sediments, a negative control sediment and a reference sediment. Each treatment consists of five replicate test chambers each containing five animals. Complete randomization of test containers and blind monitoring of response criteria should be used.

7.2 Preparation of Test Sediments: Test sediments are checked to be sure that the interstitial salinities are ≥ 20 ppt. Interstitial salinities should be checked and recorded for control, reference, and test sediments (both

initial and final). If initial interstitial salinities are not ≥20 ppt, the interstitial salinities must be adjusted as specified in the PSEP (1995) protocols. If interstitial salinities are satisfactory, the sediments may be used without further treatment.

On the day before test initiation, each sediment is mixed thoroughly using a non-contaminating implement, then an aliquot (175 ml) sufficient to make a 2-cm-deep layer is added to each of the five replicate test beakers, and the surface is smoothed. Bubbles are removed from the sediment by gently tapping each beaker against the palm of the hand. Seawater at the test temperature and salinity is added to each beaker by carefully pouring the water down the side of the chamber to the 750 mL mark. Filled chambers are then placed into the 20 ± 1 °C water bath and covered with watch glasses. An air line is inserted into the beaker under the watch glass. The chambers are then allowed to equilibrate overnight to bioassay conditions. Photoperiod during the test should be continuous illumination, using ambient laboratory lighting.

7.3 Beginning the Test: On the day of test initiation, worms are collected from the holding aquaria using a small, fine-point paint brush. The worms should be handled as little as possible; damaged or injured worms should be discarded. More worms than are needed for the bioassay are transferred to a shallow glass dish containing seawater of the test salinity and temperature. Individual worms are removed from the dish and randomly placed into plastic cups (5 worms per cup) containing seawater. Enough cups for the test plus three additional cups are prepared. Once the worms are in the cups, worms within a cup are randomly transferred to a test chamber by pouring the contents into the chamber. A squirt bottle containing seawater maintained at the test temperature and salinity can be used to free the worms that stick to the cup. During the transfer process, three of the cups containing worms are randomly selected and set aside. Worms from these cups are used to estimate initial total biomass. To determine initial total biomass, worms from these three cups are quickly rinsed with deionized water, placed on a preweighed aluminum pan, dried at 50°C to a constant weight, and weighed to the nearest 0.1 mg.

Once worms have been placed in all test chambers, each beaker is filled to a total volume of 950 mL and checked to ensure that air is flowing to the chamber and that the worms have begun to burrow into the sediment. TetraMarin_ is then provided to each beaker (40 mg/beaker). The food is preweighed into plastic cups, wetted with bioassay test water, and rinsed into the test beakers. After one hour, any worms that have not burrowed into the sediment should be replaced if they appear damaged.

During the 20-day exposure, one-third of the seawater in each beaker is replaced every third day. Prior to seawater replacement, water quality measurements are determined for each test chamber. Water replacement is achieved by removing aeration lines and siphoning one-third of the volume of test water, then replacing it with fresh 28 ± 2 ppt test water that has been maintained at 20 ± 1 °C. Care should be taken not to disturb the sediments.

7.4 Effect Criteria: Effect criteria are 1) survival after 20 days, 2) total biomass (dry weight), 3) average individual biomass (total biomass divided by the number of surviving worms), and 4) average individual growth rate.

7.5 Test Conditions: The test temperature is 20 ± 1°C. The test salinity is 28 ± 2 ppt. The dissolved oxygen concentration in each test container must be greater than 60% saturation (PSEP 1995) or 4.0 mg/L (PSDDA) throughout the 20-day test. Each beaker is supplied with oil-free compressed air provided at a rate of 150-300 mL per minute through disposable glass pipettes positioned with their tips approximately 3-4 cm below the water surface. Beakers are covered with lids to minimize evaporation and the possibility of cross contamination between beakers. The test is conducted under constant illumination of medium to low intensity.

7.6 Feeding: Animals are fed 40 mg TetraMarin® per beaker on an every-other-day basis during the test.

7.7 Test Duration, Type and Frequency of Observations, and Methods: The duration of the sediment toxicity test is 20 days. The test chambers are observed daily to ensure that adequate aeration is provided and to note the

general status of each chamber. The temperature of the environmental chamber should also be monitored daily. The type and frequency of observations to be made are summarized as follows:

TYPE OF OBSERVATION	TIMES OF OBSERVATION
Biological Data	
Survival	end of test
Biomass	end of test
Physical and Chemical Data	
Sediment interstitial salinity	beginning & end of test
Salinity, dissolved oxygen, pH, and temperature (in all beakers on days 0 & 20; in one replicate every third day)	day 0, day 20 and prior to partial replacement of test water every third day
Ammonia-N and sulfide in overlying water (optional, PSEP; required, PSDDA)	beginning & end of test*

*Further ammonia-N and sulfide monitoring is recommended prior to the first and second water renewals when initial monitoring reveals >0.7 mg/L unionized ammonia or >5.0 mg/L sulfides.

Following the exposure period, worms from each chamber are removed from the test sediment, either by gently sieving the sediment through a 0.5 mm screen or by placing the sediment in a white enamel pan of seawater, and searching for surviving worms. Worms often are in their tubes and can be removed by gently prodding either end of the tube with a fine-point paint brush. Survival is noted on a data sheet. Surviving worms are placed in a vial of clean seawater until all chambers have been sieved. Then worms from each chamber are quickly rinsed with deionized water, placed on a pre-weighed aluminum pan, dried at 50°C to a constant weight, and weighed to the nearest 0.1 mg. Prior to rinsing the worms, observations should be made to determine if food or sediment is present in the digestive tract.

Dissolved oxygen is measured directly in test bakers using a polarographic oxygen probe calibrated according to the manufacturer's recommendations. The pH is measured using a properly calibrated pH meter with scale divisions of 0.1 pH units. Temperature is measured using a calibrated mercury thermometer or a telethermometer. Salinity is measured using a refractometer. Ammonia-nitrogen is measured using the HACH Model FF-3 test kit (ammonia-N detection limit 0.1 mg/L). Sulfide is measured using the HACH Hydrogen Sulfide Test Kit Model HS-WR (sulfide detection limit 0.01 mg/L). Any observed changes in sediment color or the formation of a sediment discontinuity layer is also recorded.

7.8 Criteria of Test Acceptance: For the test to be considered acceptable, the minimum survival of organisms in the control treatment at the end of the test should be 80%.
PSDDA Performance Guidelines: Control sediment: mortality ≤10% and growth rate >0.72 mg/day. Reference sediment: mortality ≤20% and growth rate of ≥80% of that of the control sediment.
Sediment Management Standards Performance Standards: Control sediment: mortality <10% and mean individual growth rate of at least 0.72 mg/day. Reference sediment: mean individual growth rate of at least 80% of that of the control sediment.

8. DATA ANALYSIS

The mean and standard deviation are calculated for each endpoint employed (e.g. 20-day survival, 20-day total biomass, 20-day average individual biomass, and average individual growth rate) and for each treatment (i.e. test sediment). Between treatment comparisons may be made using a Student's t-test, Wilcoxon's Two-Sample test, or Mann-Whitney U test, where each treatment is compared to the control or the reference sediment. An arcsine-square root transformation of proportional data, and tests for normality and heterogeneity of variances, are performed prior to statistical comparisons.

9. REPORTING

A report of the test results must include the following information: name and identification of the test; the investigator and laboratory; information on the test, reference, and control sediments including the initial and final interstitial salinities; information on the source of seawater used; detailed information about the test organisms including acclimation conditions; a description of the experimental design and test chambers and other test conditions including water quality; information about any aeration that may have been required; definition of the effect criteria and other observations; unusual responses, if any, in the control treatment; 20-day survival in each exposure chamber and the mean and standard deviation for each treatment; initial total biomass (dry weight) for three groups of five worms; 20-day total biomass (dry weight) in each exposure chamber and the mean and standard deviation for each treatment; 20-day average individual biomass (dry weight) in each exposure chamber and the mean and standard deviation for each treatment; average individual growth rate in each exposure chamber and the mean and standard deviation for each treatment; interstitial salinity values, both initial and final, for each sediment; 96-hour LC50 with reference toxicant; a description of data analysis methods employed and documentation of statistical test results: any unusual information about the test or deviations from procedures.

10. STUDY DESIGN ALTERATION

Amendments made to the protocol must be approved by the sponsor and study director and should include a description of the change, the reason for the change, the date the change took effect, and the dated signatures of the study director and sponsor. Any deviations in the protocol must be described and recorded in the study raw data.

11. REFERENCE TOXICANT

Reference toxicant testing should be included with each study or at regular intervals as defined in the Quality Assurance Program of the laboratory.

12. REFERENCED PROCEDURES

Johns, D.M., T.C. Ginn, and D.R. Reish. 1990. Protocol for juvenile Neanthes sediment bioassay. Prepared for U.S. Env. Prot. Agency, Region 10 -Office of Puget Sound, Seattle, WA, 17 pp.

Puget Sound Dredged Disposal Analysis (PSDDA). 1989. Management plan report - unconfined open-water disposal of dredged material, Phase II - (north and south Puget Sound). Puget Sound Dredged Disposal Analysis, Army Corps of Engineers, Seattle, WA.

Puget Sound Estuary Program. 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Prepared for U.S. Env. Prot. Agency, Region 10, Office of Puget Sound, Seattle, WA, and Puget Sound Water Quality Authority, Olympia, WA.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods. Sixth Ed., The Iowa State Univ. Press. Ames, Iowa., 593 pp.

Weber, C.I. (Ed.) 1991. Methods for measuring the acute toxicity of effluents to freshwater and marine organisms (fourth edition). EPA/600/4-90/027.

13. APPROVALS

_____ for _____
Name Date

_____ for NORTHWESTERN AQUATIC SCIENCES
Name Date

APPENDIX II

RAW DATA

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4
NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

STUDY MANAGEMENT

Client: Foster-Wheeler Environmental, 10900 NE 8th St, Suite 1300, Bellevue, WA 98004
Client's Study Monitor: Mr. Gary Braun
Testing Laboratory: Northwestern Aquatic Sciences
Test Location: Newport Laboratory
Laboratory's Study Personnel:
Proj. Man./Study Dir. R.S. Caldwell
QA Officer L.K. Nemeth
1. M.S. Redmond 2. Erin Coffey 6. G.J. Irissarri
3. Bridget Mar 4. Sue Bicke
5. G. Gasbarr
Study Schedule:
Test Beginning: 7-3-98 1600 Test Ending: 7-23-98 1400

TEST MATERIAL

General description (see sample logbook/chain-of-custody for details):

NAS Sample No.:	0749F	0750F	0690F	0691F	0692F
Description:	MWA SC 23 R1	MWA SC 24 R1	MWA SC 22 R1	MWA SC 24 R1	MWA SC 25 R1
Collection Date:	5-22-98	5-22-98	5-15-98	5-15-98	5-15-98
Receipt Date:	5-28-98	5-28-98	5-18-98	5-18-98	5-18-98
Inters.Salinity (ppm):	28.0	29.0	28.5	27.0	28.0
:					

NAS Sample No.:	0721F	1024F			
Description:	MWA TANK R1	CONTROL			
Collection Date:	5-18-98	7-1-98			
Receipt Date:	5-20-98	7-1-98			
Inters.Salinity (ppm):	27.0	30.5			
:					

TEST WATER

Source: Yaquina Bay seawater
Date of Collection: 7-2-98 Salinity (ppt) 29.0 pH 7.7
Treatments: AERATED, FILTERED TO 0.4 um, SALINITY ADJUSTED W/ MILLI-Q (D.I. WA

TEST ORGANISMS

Species: Neanthes sp. Date Purchased: received 7-1-98
Source: Department of Fish & Game, California State U., Long Beach, CA
Acclimation Data:

Date	Temp (°C)	DO (mg/L)	pH	Sal (ppt)	Comments
7-1-98	21.1	6.5	7.5	34.0	RECEIVING WATER
7-2-98	20.0	~~6.5~~ 6.7	7.9	~~29.5~~ 30.0	
7-3-98	19.9	5.4	7.6	30.5	
Mean	20.3	6.2	7.7	31.5	
S.D.	0.7	0.7	0.2	2.2	
(N)	3	3	3	3	

5/1/91

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

TEST PROCEDURES AND CONDITIONS

Test chambers: 1 L glass beakers covered w/ watchglasses

Test volumes: 175 ml of test sediment; ~~1000 ml~~ 750 ml total volume 7-2-98

Replicates/treatment: (5) 35 * Organisms/treatment: (25) 25 *

Test water changes: Every third day beginning with day 3

Aeration: Yes, 3 cm below water surface

Feeding: every other day beginning with day 0

Beaker placement: Total randomization

Controls: Negative (clean sediment) ← Collected from Yaquina Bay, OR, near Rhepoxynius collection site on 7-1-98. Sieved through 1.0 mm screen, homogenized, stored at 4°C in the dark until used in test.

Positive (96-hr acute test with reference toxicant)

Photoperiod: constant light

Randomization chart:

1											
2											
3											
4											
5											

Randomization chart:

1											
2											
3											
4											
5											

TEST SCHEDULE SUMMARY

Date	7-3-98	7-4-98	7-5-98	7-6-98	7-7-98	7-8-98	7-9-98	7-10-98	7-11-98	7-12-98	7-13-98	7-14-98	7-15-98	7-16-98	7-17-98	7-18-98	7-19-98	7-20-98	7-21-98	7-22-98	7-23-98
Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Feed	X		X		X		X		X		X		X		X		X		X		
Record WQ	X			X			X			X			X			X			X		X
Change H2O				X			X			X			X			X			X		
IS/NH4/S=	X																				X
Initials	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

MISCELLANEOUS NOTES

* An additional 3 replicates were employed as water quality beakers that were sacrificed on day 0, 4, 10, and 20 for interstitial ammonia and sulfide measurements. All sacrificial beakers except those for day 0 contained test organisms. MSL 8-13-98

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-RA4

~~MARINE AMPHIPOD 10-DAY~~ SOLID PHASE SEDIMENT TEST
NEANTHES 20-DAY

Test No. 5704 Client Foster Wheeler Investigator

SEDIMENT DESCRIPTIONS--SUPLEMENTAL NOTES

Sample No.	Description
0690F	Dark Brown mud, sticks, Large gravel, rocks, sulfide odour
0691F	Dark gray, fine grain, sulfide odor, small pebbles
0692F	DARK GRAY, FINE GRAIN, SMALL PEBBLES, SOME PLANT DEBRIS
0721F	dark green/brown, fines + rocks, sandy
0749F	gray/green, fines + light sand, few dead worms
0750F	gray/green, fines, sand + silt, some dead worms, smell of death
1024F	gray sand

Revised 12-30-92

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day Ø (7/3/98) Temperature beaker 20.3 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
* 1	20.3	7.0	29.0	7.9	<0.02			YES	OK	
2	20.3	7.0	28.5	8.0						
3	20.3	7.0	29.0	7.9						
* 4	20.3	7.1	29.0	8.1	<0.02					
5	20.3	7.1	29.0	8.1						
6	20.3	7.0	29.0	7.9						
7	20.4	7.0	29.0	7.9						
8										day Ø sacrif
9	20.3	7.0	29.0	8.0						
* 10	20.4	7.0	29.0	8.2	<0.02					
* 11	20.1	7.0	29.0	8.1	<0.02					
* 12	20.2	7.0	29.0	8.1	<0.02					
13										day Ø sacrif.
14	20.2	7.0	29.0	8.0						
15	20.2	7.0	29.0	7.7						
16	20.3	7.0	29.0	8.1						
17	20.2	7.0	29.0	8.1						
18	20.1	7.0	29.0	8.0						
19	20.3	7.1	29.0	8.1						
20	20.0	7.0	29.0	8.1						
21										day 10 sacrificial
22	20.3	7.0	29.0	7.8						
23	20.3	6.8	29.0	7.8						
24										day Ø sacrif.
25	20.4	6.8	29.0	8.0						
26	20.3	6.9	29.0	8.0						
27	20.2	7.0	29.0	8.0						
28										day Ø sacrif.
* 29	20.3	7.0	29.0	7.9	<0.02	<0.02				
30										day 10 sacrificial
31										day 10 sacrific.
32	20.3	7.2	29.0	8.0						
33	20.3	7.0	29.0	8.1						
34	20.3	7.0	29.0	8.1						
35	20.3	7.0	29.0	8.0						
36	20.3	7.0	29.0	8.0						
37	20.3	7.0	29.0	8.0						
38										day Ø sacrif.
39	20.2	7.0	29.0	8.1						
40	20.4	7.0	28.5	7.9						
41	20.3	7.0	29.0	8.0						
42	20.3	6.9	29.0	7.8						
43										day Ø sacrif
44	20.3	7.0	29.0	8.0						
45	20.3	7.0	29.0	8.0						
46	20.4	7.0	29.0	8.1						
47										day 10 sacrificial

* water quality replicates

5/1/91

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day Ø (7/3/98) KM / [illegible] Temperature beaker 20.3 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
48								✓	ok	day 10 sacrifice
49										
50	20.4	6.9	29.0	7.9						
51	20.3	6.9	29.0	7.8						
52										day 10 sacr
53	20.3	6.9	29.0	7.8						
* 54	20.4	6.8	29.0	7.9	<0.02					
55										day Ø sac
56	20.3	6.8	29.0	7.8				✓	✓	

* water quality replicates

5/1/91

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 1 (7/4/98) [illegible] Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									OK	
10									↓	
11										
12										
29										
54										

Day 2 (7/5/98) [illegible] Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed (all beakers)	Air	Comments
4								yes	OK	air ~~except~~ not #4 & 54 off - re-established
10								↓	↓	
11										
12										
29										
54										

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 3 (7/6/98) 631/[illegible] Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4	20.3	6.3	30.0	7.7			YES		ALL	
10	20.4	5.9	29.0	7.9					OK	
11	20.4	6.7	29.0	7.9						
12	20.3	6.5	29.0	8.0						
29	20.3	7.0	29.0	8.3						
54	20.4	6.0	29.0	7.7						
1	20.3	5.9	30.0	7.7						

Day 4 (7/7/98) [illegible] Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4								Yes	OK	
10										
11										
12										
29										
54										
1										

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 5 (7/8/98) Temperature beaker 20.3 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									OK	
10										
11										
12										
29										
54										
1										

Day 6 (7/9/98) Temperature beaker 20.3 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4	20.4	6.2	29.0	8.1				yes	OK	
10	20.4	6.6	28.0	8.1						
11	20.3	6.5	28.0	8.0						
12	20.3	6.7	29.0	8.3						
29	20.0	6.7	27.5	8.6						
54	20.4	6.0	28.0	7.8						
1	20.4	6.5	29.0	7.9				✓	✓	

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 7 (7/10/98) Temperature beaker 20.3 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									all	
10									ok	
11										
12										
29										
54										
1										

Day 8 (7/11/98) Temperature beaker 20.2 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4								yes	all	
10									ok	
11										
12										
29										
54										
1										

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 9 (7/12/98) Temperature beaker 20.3°C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4	20.4	6.2	28.5	7.9			Yes		~~OK~~ off	
10	20.4	6.2	27.5	8.1						
11	20.3	6.3	28.5	7.9						
12	20.3	6.2	29.0	8.1						
29	20.2	6.9	29.0	8.5						
54	20.4	6.2	28.5	7.7						
1	20.4	6.4	28.0	7.7						

Day 10 (7/13/98) Temperature beaker 20.4°C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									OK	
10									OK	
11									OK	
12									OK	
29									~~OK~~ off	Breakers 14
54										
1										
										56 Reestablished

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 11 (7/14/98) Temperature beaker 20.5 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									OK	
10										
11										
12										
29										
54										
1										

Day 12 (7/15/98) Temperature beaker 20.2 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4	20.4	6.7	28.0	8.0			YES	YES	OK	
10	20.4	6.6	28.0	8.4						
11	20.3	6.7	28.0	8.0						
12	20.3	6.7	28.0	8.3						
29	20.3	6.8	29.0	8.5						
54	20.4	6.4	28.0	8.0						
1	20.4	6.7	28.0	8.0						

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 13 (7/16/98) 85 Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									ok	
10										
11										
12										
29										
54										
1										

Day 14 (7/17/98) 85 Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4								1/2 S	ok	
10										
11										
12										
29										
54										
1										

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 15 (7/18/98) Temperature beaker 20.6 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4	20.5	6.5	28.0	7.7			yes		OK	
10	20.6	6.8	28.0	7.9						
11	20.5	6.4	28.0	7.8						
12	20.5	6.6	28.0	8.1						
29	20.5	6.6	29.0	8.4						
54	20.7	6.2	28.0	7.9						
1	20.5	6.4	28.0	7.7						

Day 16 (7/19/98) Temperature beaker 20.7 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4								yes	OK	
10										
11										
12										
29										
54										
1										

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 17 (7/20/98) Temperature beaker 20.5 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									OK	
10										
11										
12										
29										
54										
1										

Day 18 (7/21/98) 6 SL Temperature beaker 20.6 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4	20.6	7.0	28.0	7.9			YES	YES	OK	
10	20.6	7.2	28.0	8.1						
11	20.7	7.1	28.0	8.2						
12	20.6	7.1	28.0	8.0						
29	20.6	7.2	29.0	8.2						
54	20.5	7.2	27.5	8.5						
1	20.6	6.9	27.0	8.0						

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 19 (7/22/98) MS Temperature beaker 20.5 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4									OK	
10										
11										
12										
29										
54										
1										

Day ____ (/ /) Temperature beaker ____ °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
4										
10										
11										
12										
29										
54										

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NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 570-4 Client Foster-Wheeler Investigator

DAILY RECORD SHEET

Day 20 (7/23/98) 85 Temperature beaker 20.4 °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
* 1	20.5	6.6	28.0	8.0	<0.02					
2	20.5	6.7	28.0	8.2						
3	20.5	6.7	28.0	8.2						
* 4	20.6	6.6	28.0	8.2	<0.02					
5	20.6	6.8	28.0	8.2						
6	20.4	6.7	29.0	8.5						
7	20.7	7.1	28.0	7.9						
8										day ϕ sacrif.
9	20.5	6.7	28.0	8.4						
* 10	20.6	7.0	28.0	8.3	<0.02					
* 11	20.6	6.9	27.0	8.1	<0.02					
* 12	20.5	6.8	28.0	8.3	<0.02					
13										day ϕ sacrif.
14	20.5	7.0	28.0	8.5						
15	20.4	6.9	28.0	8.1						
16	20.5	6.9	28.0	8.3						
17	20.5	6.9	28.0	8.2						
18	20.5	6.9	28.0	8.1						
19	20.5	7.0	28.0	8.1						
20	20.5	7.0	28.0	8.4						
21										day 10 sacrificial
22	20.7	6.9	28.0	8.3						
23	20.5	6.6	28.0	8.5						
24										day ϕ sacrif.
25	20.6	7.0	28.0	8.2						
26	20.5	6.9	28.0	8.2						
27	20.5	6.9	28.0	8.4						
28										day ϕ sacrif.
* 29	20.5	7.0	29.0	8.6	<0.02					
30										day 10 sacrificial
31										day 10 sacrificial
32	20.5	6.9	28.0	8.5						
33	20.5	6.8	28.0	8.3						
34	20.6	7.0	28.0	8.2						
35	20.6	6.9	28.0	8.2						
36	20.6	6.9	28.0	8.2						
37	20.6	6.8	28.0	8.6						
38										day ϕ sacrif.
39	20.6	6.8	28.0	8.1						
40	20.7	7.0	28.0	8.1						
41	20.6	6.8	28.0	8.1						
42	20.6	6.7	28.0	8.3						
43										day ϕ sacrif.
44	20.6	7.0	28.0	8.5						
45	20.6	7.0	28.0	8.2						
46	20.6	6.9	28.0	8.4						
47										day 10 sacrificial

* water quality replicates

5/1/91

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator _____

DAILY RECORD SHEET

Day 20 (7/23/98) Temperature beaker _____ °C

Beaker No.	Temp. (°C)	DO (ppm)	Sal. (ppt)	pH	S (ppm)	NH3 (ppm)	Water changed	Fed	Air	Comments
48										day 10 sacrifice
49										
50	20.7	6.8	28.0	8.1						
51	20.6	7.0	28.0	8.1						
52										day 10 sac
53	20.6	7.0	28.0	8.1						
* 54	20.6	6.9	28.0	8.0	<0.02					
55										day ∅ sac
56	20.7	6.8	28.0	8.2						

* water quality replicates

5/1/91

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator

DAY 20 TEST TERMINATION SHEET

Beaker No.	Interstitial salinity (ppt)	Number of survivors	Initial
* 1	—	—	
2	28.0	4	GAB
3	28.0	5	GAB
* 4	—	—	
5	27.5	5	GAB
6	28.0	5	GAB
7	27.5	5	GAB
8			
9	28.0	5	GAB
* 10	—	—	
* 11	—	—	
* 12	—	—	
13			
14	28.0	~~4~~ 5	GAB
15	27.5	5	GAB
16	28.0	5	GAB
17	28.0	5	GAB
18	28.0	5	GJL
19	28.0	5	GAB
20	28.0	5	GAB
21			
22	28.0	5	GAB
23	28.0	5	GAB
24			
25	28.0	4	GAB
26	28.0	5	GAB
27	28.0	5	GAB
28			
* 29	—	—	
30			
31			
32	28.0	5	GAB
33	27.5	5	GJL
34	28.0	4	GAB
35	27.5	5	GJL
36	28.0	5	GAB
37	28.0	5	GAB
38			
39	28.0	5	GJL
40	28.0	5	GAB
41	28.0	5	GJL
42	27.5	5	GAB
43			
44	28.0	5	GAB
45	28.0	2	GJL
46	28.0	5	GAB
47			
48			

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No 5904 Client Foster-Wheeler Investigator

DAY 20 TEST TERMINATION SHEET

Beaker No.	Interstitial salinity (ppt)	Number of survivors	Initial
49			
50	27.5	5	
51	27.5	5	
52			
53	28.C	4	GJ
54			
55			
56	28.C	4	GJ

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-XXX-NA4

NEANTHES SP. 20 DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Environmental Investigator _____

ZERO-TIME WEIGHING DATA SHEET

Tare: Date 7-3-98 Oven Temp(°C) 50°C Drying Time(Hr.) 24 Initials MLR

Final: Date 7-8-98 Oven Temp(°C) 50 °C Drying Time(Hr.) 24 Initials [illegible]

Equip. Used: Oven Blue M Balance Sartorius M3P

Pan #	Tare wt. (mg)	Total wt. (mg) 1	2	3	#weighed	
1	30.878	31.785	31.788		5	0.182
2	31.430	32.456	32.456		5	0.205
3	33.390	34.123	34.124		5	0.147
4						
5						
6						
		in: 7/3/98 1630	7/8/98 [illegible]			

100.000 mg weight = 100.024 mg 7-3-98 MLR

" = 100.024 [illegible] 7/3/98

" 100.020 [illegible] 7/8/98

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO: _____

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster - Wheeler Investigator _____

WEIGHING DATA SHEET

Tare: Date 7-21-98 Oven temp (C.) 50 Drying time (hr.) 24 Initials JRF
Final: Date 7-24-98 Oven temp (C.) 50 Drying time (hr.) 24 Initials JRF
Equip. used: Oven Precision Balance Sartorius

Beaker #	Pan #	Tare wt. (mg)	Total wt. (mg) 1	2	3	#weighed	Comments
1	1	56.59	—	—	—	—	
2	2	61.86	94.67	94.63	94.61	4	
3	3	57.35	114.65	114.26	114.16	5	Animals were dried at 50C
4	4	67.73	—	—	—	—	for 24 H & weighed
5	5	58.10	127.88	127.32	127.12	5	on 7/24 & stored in
6	6	61.70	96.62	96.40	96.32	5	the dessicator -
7	7	61.52	105.72	105.32	105.18	5	Redried for 24H
8	8	59.58	—	—	—	—	and weighed again.
9	9	62.52	~~94.52~~	~~~~94.17	~~~~94.08	~~~~5	JRF 7/28/98
10	10	65.52	—	—	—	—	
11	11	61.14	—	—	—	—	
12	12	60.96	—	—	—	—	
13	13	60.77	—	—	—	—	
14	14	66.74	106.77	~106.47	106.36	5	
15	15	66.90	105.50	105.26	105.15	5	
16	16	61.88	108.11	108.07	107.83	5	
17	17	62.97	124.97	123.90	123.77	5	
18	18	67.72	109.69	109.28	109.18	5	
19	19	66.90	109.71	109.29	109.11	5	
20	20	65.89	109.41	109.07	108.95	5	
21	21	62.61	—	—	—	—	
22	22	63.44	99.96	99.72	99.63	5	
23	23	58.17	83.74	82.50	82.44	5	
24	24	58.74	—	—	—	—	
25	25	59.70	131.62	131.12	130.90	~~3~~ 4	
26	26	61.30	108.81	108.28	108.07	5	
27	27	64.96	97.27	97.10	96.99	5	
28	28	59.57	—	—	—	—	
29	29	56.55	—	—	—	—	
30	30	60.48	—	—	—	—	
31	31	66.30	—	—	—	—	
32	32	67.75	97.57	97.26	97.11	5	
33	33	70.04	108.69	108.59	108.59	5	
34	34	61.40	102.76	102.24	102.20	4	
35	35	60.12	129.67	129.93	129.86	5	
36	36	59.35	132.21	131.39	131.29	5	
37	37	59.68	109.67	109.36	109.29	5	
38	38	69.06	—	—	—	—	
39	39	57.82	114.95	114.39	114.28	5	
40	40	66.02	133.25	132.40	132.33	5	
41	41	62.05	110.51	110.02	109.54	5	

JRF 7-21-98 102mg std wt = 102.01 mg
JRF 7-24-98 102mg std wt = 102.02 mg
JRF 7-28-98 102mg std wt = 102.02 mg
7-29-98 JRF 102mg std wt = 102.02 mg

NEANTHES.WTS

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO: _____

NEANTHES SP. 20-DAY SOLID PHASE SEDIMENT TEST

Test No. 590-4 Client Foster-Wheeler Investigator _____

WEIGHING DATA SHEET

Tare: Date 7-21-98 Oven temp (C.) 50 Drying time (hr.) 24 Initials JNF
Final: Date 7-24-98 Oven temp (C.) 50 Drying time (hr.) 24 Initials JNF
Equip. used: Oven Precision Balance Sartorius

Beaker #	Pan #	Tare wt. (mg)	Total wt. (mg) 1	2	3	#weighed	Comments		
42	42	62.47	124.60	123.87	123.66	5			
43	43	69.58	—	—	—	—			
44	44	60.10	116.57	116.46	116.29	5			
45	45	57.72	89.10	88.55	88.70	2			
46	46	60.79	111.80	111.42	111.23	5			
47	47	60.40	—	—	—	—			
48	48	65.09	—	—	—	—			
49	49	58.49	—	—	—	—			
50	50	64.14	138.06	138.34	138.18	5			
51	51	60.40	106.51	106.28	106.20	5			
52	52	59.69	—	—	—	—			
53	53	61.12	114.79	113.66	113.74	4			
54	54	55.17	—	—	—	—			
55	55	56.70	—	—	—	—			
56	56	58.24	111.15	109.37	108.28	4			
57	57								
58	58								
59	59								
60	60								
61	61								
62	62								
63	63								
64	64								
65	65								
66	66								
67	67								
68	68								
69	69								
70	70								
71	71								
72	72								
73	73								
74	74								
75	75								
76	76								
77	77								
78	78								
79	79								
80	80								
81	81								
82	82								
83	83								

R
7-10

NEANTHES.WTS

Randomization Key

BKR	NAS SMPL	CLIENT DESCRIP	REPL	
35	0749F	MWRC208R1	1	
16	0749F	MWRC208R1	2	
26	0749F	MWRC208R1	3	
39	0749F	MWRC208R1	4	
5	0749F	MWRC208R1	5	
4	0749F	MWRC208R1	6	water quality replicate
21	0749F	MWRC208R1	7	day 10 sacrificial beaker
28	0749F	MWRC208R1	8	day 0 sacrificial beaker
33	0750F	MWRC209R1	1	
46	0750F	MWRC209R1	2	
27	0750F	MWRC209R1	3	
2	0750F	MWRC209R1	4	
42	0750F	MWRC209R1	5	
10	0750F	MWRC209R1	6	water quality replicate
31	0750F	MWRC209R1	7	day 10 sacrificial beaker
38	0750F	MWRC209R1	8	day 0 sacrificial beaker
45	0690F	MWAS022R1	1	
3	0690F	MWAS022R1	2	
40	0690F	MWAS022R1	3	
19	0690F	MWAS022R1	4	
53	0690F	MWAS022R1	5	
54	0690F	MWAS022R1	6	water quality replicate
48	0690F	MWAS022R1	7	day 10 sacrificial beaker
43	0690F	MWAS022R1	8	day 0 sacrificial beaker
56	0691F	MWAS024R1	1	
14	0691F	MWAS024R1	2	
22	0691F	MWAS024R1	3	
37	0691F	MWAS024R1	4	
44	0691F	MWAS024R1	5	
29	0691F	MWAS024R1	6	water quality replicate
30	0691F	MWAS024R1	7	day 10 sacrificial beaker
55	0691F	MWAS024R1	8	day 0 sacrificial beaker
20	0692F	MWAS025R1	1	
9	0692F	MWAS025R1	2	
32	0692F	MWAS025R1	3	
6	0692F	MWAS025R1	4	
23	0692F	MWAS025R1	5	
12	0692F	MWAS025R1	6	water quality replicate
49	0692F	MWAS025R1	7	day 10 sacrificial beaker
8	0692F	MWAS025R1	8	day 0 sacrificial beaker
18	0721F	MWAT040R1	1	
7	0721F	MWAT040R1	2	
15	0721F	MWAT040R1	3	
41	0721F	MWAT040R1	4	
51	0721F	MWAT040R1	5	
11	0721F	MWAT040R1	6	water quality replicate
47	0721F	MWAT040R1	7	day 10 sacrificial beaker
24	0721F	MWAT040R1	8	day 0 sacrificial beaker

Randomization Key

17	1024F	control	1	
25	1024F	control	2	
50	1024F	control	3	
34	1024F	control	4	
36	1024F	control	5	
1	1024F	control	6	water quality replicate
52	1024F	control	7	day 10 sacrificial beaker
13	1024F	control	8	day 0 sacrificial beaker

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-98

Description of analytical group: Nesbitt Chemic, Fritz Tender [illegible] mixing UH3 [illegible]

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1 (1024F)		2.5																		
2	4 (0749F)			2.5																	
3	10 (0750F)				2.5					1.0											
4	11 (0721F)					2.5										Fresh	Sw	Std			
5	12 (0692F)						2.5												mg/L	cal	
6	21 (0691F)							2.5							Std	(mg/L)			cm	(mg/L)	
7	54 (0690F)								2.5												
8																10			10.5		
9																3			3.6		
10																1			1.1		
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4											
	Measured concentration (mg/L)		.1	1.0	>2.5	1.2	1.8	1.4	.6	.3											
	x multiplier		2	2	2	2	2	2	2	2											
	Final concentration (mg/L)		.2	2.0	-	2.4	3.6	2.8	1.2	1.5											

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-98

Description of analytical group: [illegible]

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1		10																		
2	4			10																	
3	10				10																
4	11					10									[illegible]						
5	[illegible]						10														
6	[illegible]							10													
7	54								10						[illegible]						
5																					
9																10			10.5		
10																3			3.6		
11																1			1.1		
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	4	4	4	4	4	4	4	4												
	Measured concentration (mg/L)		.5	.5	.8	.1	.1	.3	.1												
	x multiplier		.5	.5	.5	.5	.5	.5	.5												
	Final concentration (mg/L)		.2	1.5	.4	.5	.5	1.5	.5												

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-95 (3)

Description of analytical group: [illegible]

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1		2.5																		
2	4			2.5																	
3	10				2.5																
4	11					2.5									Ammonia				std		
5	12						2.5			1.0											
6	29							2.5							std	(ppm	(L)		(ppm	(ppm	(L)
7	34								2.5												
8																10			10.5		
9																3			3.6		
10																1			1.1		
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4											
	Measured concentration (mg/L)		2.1	.5	1.25	.2	1.25	.5	.5	1.0											
	x multiplier		2	2	2	2	2	2	2	5											
	Final concentration (mg/L)		4.2	1.0	-	.4	-	1.0	1.0	5.0											

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-98

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1		2.5																		
2	4			2.5																	
3	10				2.5					1.0											
4	11					2.5										Ammonia			Std		
5	12						2.5				1.0								Neci	11.5	
6	29							2.5							Std	(mg	1L)		mix	(mg/L)	
7	30								2.5			1.0									
5																10			10.5		
9																3			3.6		
10																1			1.1		
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater		2.5	2.5	2.5	2.5	2.5	2.5	2.5	1	1	1									
	Measured concentration (mg/L)		2.1	2.5		.41	>2.5	1.4	>2.5	1.6	.4	.2									
	x multiplier		2	2		2	2	2	2	5	5	5									
	Final concentration (mg/L)		4.2	5		.8	–	2.8	–	8	2	1									

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanuarate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-98 BS

Description of analytical group: Alkalinity, chloride, fluoride, sulfate, bromide, SM-4, carbonate, nitrate, NH3 TKN 1 2

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1		2.5																		
2	4			2.5																	
3	10				2.5					1.0											
4	11					2.5										Std	Stock		Std		
5	12						2.5				1.0								Measured		
6	29							2.5								Std (mg/L)			Conc. (mg/L)		
7	54								2.5			1.0				10			10.5		
5																3			3.6		
9																1			1.1		
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4	4	4									
	Measured concentration (mg/L)		1.4	.8	>2.5	.4	>2.5	1.5	>2.5	1.3	.8	.4									
	x multiplier		2	2	2	2	2	2	2	5	5	5									
	Final concentration (mg/L)		2.8	1.6		.8		3.0		6.5	4	2									

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater																				
	Measured concentration (mg/L)																				
	x multiplier																				
	Final concentration (mg/L)																				

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-95 JF

Description of analytical group: [illegible]

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1		2.5																		
2	4			2.5																	
3	10				2.5																
4	11					2.5											Ammonia Std				
5	12						2.5														
6	29							2.5							Std (mg/L)				Prepared Conc (mg/L)		
7	5c1								2.5	1.0											
8																10			10.5		
9																3			3.6		
10																1			1.1		
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5c	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4											
	Measured concentration (mg/L)		2.2	.2	.3	.1	2.1	.1	>2.5	.5											
	x multiplier		2	2	2	2	2	2	2	5											
	Final concentration (mg/L)		4.4	.4	.6	.2	4.2	.2	-	2.5											

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanuarate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - AMMONIA-N

7-27-97

Description of analytical group: [illegible]

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1		2.5																		
2	4			2.5																	
3	10				2.5																
4	11					2.5															
5	12						2.5														
6	29							2.5													
7	54								2.5	1.0											
5																10			10.5		
9																3			3.6		
10																1			1.1		
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4											
	Measured concentration (mg/L)		2.0	.1	.1	.1	.2	.1	>2	.4											
	x multiplier		2	2	2	2	2	2	2	2											
	Final concentration (mg/L)		4.0	.2	.2	.2	.4	.2	–	.2											

Standards (mg/L): 10, 3, 1

Measured conc. (mg/L): 10.5, 3.6, 1.1

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing.

ANALYSIS BENCHSHEET - SULFIDE

Description of analytical group: Test 590-4, Mean Plus Chronic. Day 0 initial Sulfide.

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	8 (0692F)	~~1.0~~	1.0																		
2	17 (1024F)			1.0																	
3	24 (0721F)				1.0																
4	28 (0749F)					1.0															
5	38 (0750F)						1.0														
6	43 (0670F)							1.0													
7	55 (0691F)								1.0												
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater or DI water	5.0	4.0	→																	
	Measured concentration (mg/L)	<.10	<.10	—	<.10	<.10	<.10	<.10	<.10												
	x multiplier	1	5	→																	
	Final concentration (mg/L)	<.10	<.50	—	<.50	<.50	<.50	<.50	<.50												

Add sufficient seawater to make 5 ml. Then add 0.2 ml sulfuric acid reagent (stir), followed by 0.2 ml dichromate reagent (stir)

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group: Test 590-4, Memphis chronic. Day Ø interstitial NH3.

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	8 (0692F)		.2	1.0																	
2	13 (1024F)				.2	1.0															
3	24 (0721F)						.2	1.0									Ammonia QC Std				
4	28 (0749F)								.2	1.0											
5	38 (0750F)										.2	1.0					Std (mg/L)		Measured Conc (mg/L)		
6	43 (0690F)												.2	1.0			10.0				
7	55 (0691F)													~~1.0~~	.2	1.0	3.0				
8																	1.0				
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5.0	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4					
	Measured concentration (mg/L)		0.6	2.4	—	—	—	2.0	—	2.5	1.5	>2.5	0.3	1.5	0.5	2.4					
	x multiplier		25	5	25	5	25	5	25	5	25	5	25	5	25	5					
	Final concentration (mg/L)		15	12	—	—	—	10	—	12.5	37.5	>12.5	7.5	7.5	12.5	12.0					
	$\bar{X}$		13.5										7.5		12.2						

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanuarate reagent packet contents with mixing.

7-21-95

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group: [illegible]

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	49 (0.0612 F)		.2	1.0																	
2	52 (1.024 F)				.2	1.0															
3	47 (0.721 F)						.2	1.0										Ammonia	QC std		
4	21 (0.749 F)								.2	1.0								Std (mg/L)	conc. (mg/L)		
5	31 (0.250 F)										.2	1.0									
6	45 (0.0900 F)												.2	1.0				10.0	10.3		
7	30 (0.511 F)														.2	1.0		3.0	3.2		
8																		1.0	1.3		
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5.0	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4					
	Measured concentration (mg/L)		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
	x multiplier		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
	Final concentration (mg/L)		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]						
	$\bar{x}$		11.5				12.2														

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing

7-24-98

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group: Test 3510-41 Neanthes chronic Day 20 Interstitial NH3 85

	R# Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	11 (0721F)		.2	1.0																	
2	12 (0692F)				.2	1.0															
3	29 (0691F)						.2	1.0													
4	54 (0690F)								.2	1.0								Ammonia	std		
5	10 (0750F)										.2	1.0									
6	4 (0749F)												.2	1.0				std (mg/l)		transferred corr. for 1L	
7	1 (1024F)														.2	1.0					
8																		10.0		10.5	
9																		3.0		3.2	
10																		1.0		1.3	
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater	5.0	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4					
	Measured concentration (mg/L)		0.2	0.1	0.2	1.1	0.1	0.3	0.2	1.0	0.2	1.1	0.1	1.1							
	x multiplier		25	5	25	5	25	5	25	5	25	5	25	5	25	5					
	Final concentration (mg/L)		5	4.5	5	6	2.5	1.5	5	5	5	5.5	2.5	5.5							
	$\bar{x}$		4.8		5.5		2.0		6.5		5.2		4.0								

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanurate reagent packet contents with mixing

Interstitial sulfide 5-26-98 BC-/83 P590

ANALYSIS BENCHSHEET - SULFIDE

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	054 R1	1.0																			
2	048 R1		1.0																		
3	049 R1			1.0																	
4	0401				1.0																
5	025 R1					1.0															
6	052 R1						1.0														
7	043 R1							1.0													
8	039 R1								1.0												
9	024 R1									1.0											
10	022 R1										1.0										
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
	Seawater or DI water	4mL									4										
	Measured concentration (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01										
	x multiplier	5									5										
	Final concentration (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05										

Add sufficient seawater to make 5 ml. Then add 0.2 ml sulfuric acid reagent (stir), followed by 0.2 ml dichromate reagent (stir)

Tentative ammonias 5-26-98 RC 8/13 P590

ANALYSIS BENCHSHEET - AMMONIA-N

Description of analytical group

	Sample description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	054 R1	0.2	1																		
2	045 R1			0.2	1																
3	049 R1					0.2	1														
4	0401							0.2	1												
5	025 R1									0.2	1										
6	052 R1											0.2	1								
7	043 R1													0.2	1						
8	039 R1															0.2	1				
9	024 R1																	0.2	1		
10	022 R1																			0.2	1
11	Ammonia QC Standard																				
12																					
13			Std (mg/L)				Measured Conc. (mg/L)														
14			10				10.0														
15			3.0				3.0														
16			1.0				1.0														
17																					
18																					
	Seawater	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4	4.8	4
	Measured concentration (mg/L)	0.1	0.6	0.2	1.5	0.1	0.7	0.2	1.2	0.3	1.4	0.1	0.9	0.2	1.1	0.2	1.1	0.4	1.5	0.2	1.3
	x multiplier	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5	25	5
	Final concentration (mg/L)	2.5	3.0	5.0	5.5	2.5	3.5	5.0	6.0	7.5	7.0	2.5	4.0	5.0	5.5	5.0	5.5	10.0	7.5	5.0	6.5
	x̄ =	2.8		5.2		3.0		5.5		7.2		3.2		5.2		5.2		10.0		5.8	

Add sufficient seawater to make 5 ml. Then add one salicylate followed by one cyanuarate reagent packet contents with mixing.

Endpoints Data Entry and Calculations File

BKR=beaker number (=pan number)
INIT NO.=initial number of worms exposed
FINAL IW PPT=interstitial salinity in ppt on day 20
SURV=number of worms surviving after 20 days
MORT=number of worms dead after 20 days
INIT WT=mean weight of worms sampled on day zero (mg)
TARE WT=weight of pan used for that replicate on day 20 (mg)
WT COUNT=number of worms weighed at test end
FINAL WT=TARE WT + weight of worms recovered on day 20 (mg)
PSURV=% SURV=100(SURV/INIT NO)
TWT=total biomass=FINAL-TARE
WT=individual biomass=TWT/WT COUNT
GR=individual growth rate=(WT-INIT WT)/20

Data entry verified by LK Demetrio 8-13-98
ZMR 8-17-98

INIT WT

pan#	tare wt	total wt	# weighe	individual wt
1	30.88	31.79	5	0.18
2	31.43	32.46	5	0.21
3	33.39	34.12	5	0.15
			MEAN	0.18

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT NO.	FINAL IW PPT	SURV	MORT	INIT WT	TARE WT	WT COUNT	FINAL WT	PSURV	PMORT	TWT	WT	GR		FINAL IW PPT	TWT	WT	GR	PSUR
1	35	0749F	MWRC208R1	1		5	27.5	5	0	0.18	60.12	5	128.88	100.0	0.0	68.8	13.8	0.68						
2	16	0749F	MWRC208R1	2		5	28.0	5	0	0.18	61.88	5	107.83	100.0	0.0	46.0	9.2	0.45	Mean	27.8	57.0	11.4	0.56	100.0
3	26	0749F	MWRC208R1	3		5	28.0	5	0	0.18	61.30	5	108.07	100.0	0.0	46.8	9.4	0.46	S.D.	0.3	11.4	2.3	0.11	0.0
4	39	0749F	MWRC208R1	4		5	28.0	5	0	0.18	59.82	5	114.28	100.0	0.0	54.5	10.9	0.54	n	5	5	5	5	5
5	5	0749F	MWRC208R1	5		5	27.5	5	0	0.18	58.10	5	127.12	100.0	0.0	69.0	13.8	0.68						
6	4	0749F	MWRC208R1	6	water quality replicate																			
7	21	0749F	MWRC208R1	7	day 10 sacrificial beaker																			
8	28	0749F	MWRC208R1	8	day 0 sacrificial beaker																			
9	33	0750F	MWRC209R1	1		5	27.5	5	0	0.18	70.04	5	108.59	100.0	0.0	38.6	7.7	0.38						
10	46	0750F	MWRC209R1	2		5	28.0	5	0	0.18	60.79	5	111.23	100.0	0.0	50.4	10.1	0.50	Mean	27.8	43.0	8.9	0.44	96.0
11	27	0750F	MWRC209R1	3		5	28.0	5	0	0.18	64.96	5	96.99	100.0	0.0	32.0	6.4	0.31	S.D.	0.3	12.6	2.3	0.11	8.9
12	2	0750F	MWRC209R1	4		5	28.0	4	1	0.18	61.88	4	94.61	80.0	20.0	32.7	8.2	0.40	n	5	5	5	5	5
13	42	0750F	MWRC209R1	5		5	27.5	5	0	0.18	62.47	5	123.66	100.0	0.0	61.2	12.2	0.60						
14	10	0750F	MWRC209R1	6	water quality replicate																			
15	31	0750F	MWRC209R1	7	day 10 sacrificial beaker																			
16	38	0750F	MWRC209R1	8	day 0 sacrificial beaker																			
17	45	0690F	MWAS022R1	1		5	28.0	2	3	0.18	57.72	2	88.70	40.0	60.0	31.0	15.5	0.77						
18	3	0690F	MWAS022R1	2		5	28.0	5	0	0.18	57.35	5	114.16	100.0	0.0	56.8	11.4	0.56	Mean	28.0	51.0	12.6	0.62	84.0
19	40	0690F	MWAS022R1	3		5	28.0	5	0	0.18	66.08	5	132.33	100.0	0.0	66.3	13.3	0.65	S.D.	0.0	13.0	2.2	0.11	26.1
20	19	0690F	MWAS022R1	4		5	28.0	5	0	0.18	60.90	5	109.11	100.0	0.0	48.2	9.6	0.47	n	5	5	5	5	5
21	53	0690F	MWAS022R1	5		5	28.0	4	1	0.18	61.12	4	113.74	80.0	20.0	52.6	13.2	0.65						
22	54	0690F	MWAS022R1	6	water quality replicate																			
23	48	0690F	MWAS022R1	7	day 10 sacrificial beaker																			
24	43	0690F	MWAS022R1	8	day 0 sacrificial beaker																			
25	56	0691F	MWAS024R1	1		5	28.0	4	1	0.18	58.24	4	108.28	80.0	20.0	50.0	12.5	0.62						
26	14	0691F	MWAS024R1	2		5	28.0	5	0	0.18	66.74	5	106.36	100.0	0.0	39.6	7.9	0.39	Mean	28.0	45.1	9.5	0.47	98.0
27	22	0691F	MWAS024R1	3		5	28.0	5	0	0.18	63.44	5	99.63	100.0	0.0	36.2	7.2	0.35	S.D.	0.0	6.7	2.1	0.10	8.9
28	37	0691F	MWAS024R1	4		5	28.0	5	0	0.18	59.68	5	109.29	100.0	0.0	49.6	9.9	0.49	n	5	5	5	5	5
29	44	0691F	MWAS024R1	5		5	28.0	5	0	0.18	66.10	5	116.29	100.0	0.0	50.2	10.0	0.49						
30	29	0691F	MWAS024R1	6	water quality replicate																			
31	30	0691F	MWAS024R1	7	day 10 sacrificial beaker																			
32	55	0691F	MWAS024R1	8	day 0 sacrificial beaker																			

INDEX	BKR	NAS SMPL	CLIENT DESCRIP	REPL		INIT NO.	FINAL IW PPT	SURV	MORT	INIT WT	TARE WT	WT COUNT	FINAL WT	PSURV	PMORT	TWT	WT	GR			FINAL IW PPT	TWT	WT	GR	PSUR
33	20	0692F	MWAS025R1	1		5	28.0	5	0	0.18	65.89	5	108.95	100.0	0.0	43.1	8.6	0.42							
34	9	0692F	MWAS025R1	2		5	28.0	5	0	0.18	62.52	5	94.08	100.0	0.0	31.6	6.3	0.31		Mean	28.0	32.6	6.5	0.32	100.0
35	32	0692F	MWAS025R1	3		5	28.0	5	0	0.18	67.78	5	97.11	100.0	0.0	29.3	5.9	0.28		S.D.	0.0	7.0	1.4	0.07	0.0
36	6	0692F	MWAS025R1	4		5	28.0	5	0	0.18	61.70	5	96.32	100.0	0.0	34.6	6.9	0.34		n	5	5	5	5	5
37	23	0692F	MWAS025R1	5		5	28.0	5	0	0.18	58.17	5	82.44	100.0	0.0	24.3	4.9	0.23							
38	12	0692F	MWAS025R1	6	water quality replicate																				
39	49	0692F	MWAS025R1	7	day 10 sacrificial beaker																				
40	8	0692F	MWAS025R1	8	day 0 sacrificial beaker																				
41	18	0721F	MWAT040R1	1		5	28.0	5	0	0.18	67.72	5	109.18	100.0	0.0	41.5	8.3	0.41							
42	7	0721F	MWAT040R1	2		5	27.5	5	0	0.18	61.52	5	105.18	100.0	0.0	43.7	8.7	0.43		Mean	27.7	43.4	8.7	0.43	100.0
43	15	0721F	MWAT040R1	3		5	27.5	5	0	0.18	66.90	5	105.15	100.0	0.0	38.3	7.7	0.37		S.D.	0.3	3.7	0.7	0.04	0.0
44	41	0721F	MWAT040R1	4		5	28.0	5	0	0.18	62.05	5	109.84	100.0	0.0	47.8	9.6	0.47		n	5	5	5	5	5
45	51	0721F	MWAT040R1	5		5	27.5	5	0	0.18	60.40	5	106.20	100.0	0.0	45.8	9.2	0.45							
46	11	0721F	MWAT040R1	6	water quality replicate																				
47	47	0721F	MWAT040R1	7	day 10 sacrificial beaker																				
48	24	0721F	MWAT040R1	8	day 0 sacrificial beaker																				
49	17	1024F	control	1		5	28.0	5	0	0.18	62.97	5	123.77	100.0	0.0	60.8	12.2	0.60							
50	25	1024F	control	2		5	28.0	4	1	0.18	59.70	4	130.90	80.0	20.0	71.2	17.8	0.88		Mean	27.9	63.7	13.9	0.68	92.0
51	50	1024F	control	3		5	27.5	5	0	0.18	64.14	5	138.18	100.0	0.0	74.0	14.8	0.73		S.D.	0.2	13.8	2.9	0.14	11.0
52	34	1024F	control	4		5	28.0	4	1	0.18	61.46	4	102.20	80.0	20.0	40.7	10.2	0.50		n	5	5	5	5	5
53	36	1024F	control	5		5	28.0	5	0	0.18	59.35	5	131.29	100.0	0.0	71.9	14.4	0.71							
54	1	1024F	control	6	water quality replicate																				
55	52	1024F	control	7	day 10 sacrificial beaker																				
56	13	1024F	control	8	day 0 sacrificial beaker																				

Neanthes 20-day Growth Test-20-day Survival

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWRC209R1	1.0000	1.0000	1.0000	0.8000	1.0000
MWAS022R1	0.4000	1.0000	1.0000	1.0000	0.8000
MWAS024R1	0.8000	1.0000	1.0000	1.0000	1.0000
MWAS025R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT040R1	1.0000	1.0000	1.0000	1.0000	1.0000
control	1.0000	0.8000	1.0000	0.8000	1.0000

Comparisons made against reference sediment MWRC208R1.

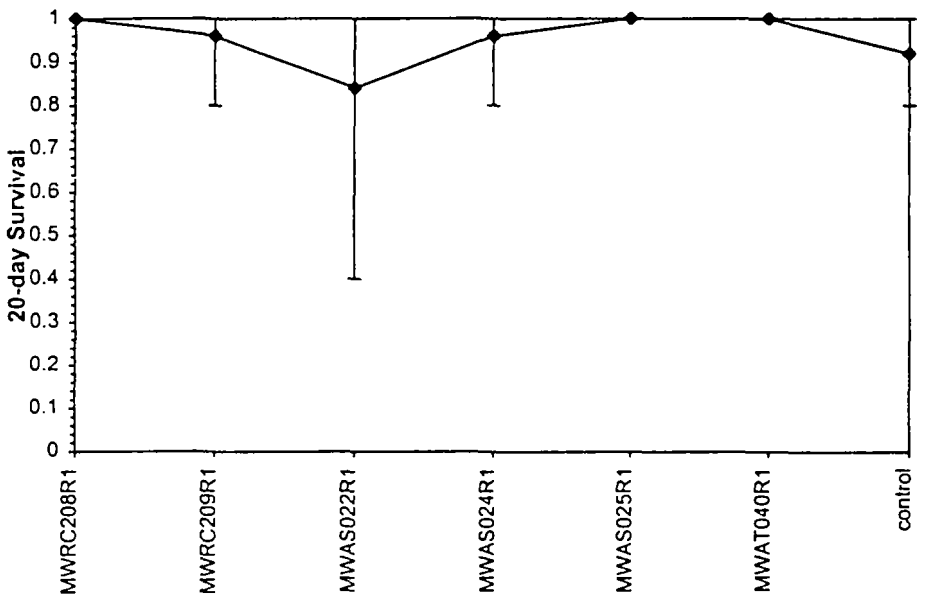
			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5			
MWRC209R1	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5			
MWAS022R1	0.8400	0.8750	1.1655	0.6847	1.3453	24.700	5	1.396	2.132	0.0353
MWAS024R1	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5	1.000	2.132	0.0048
MWAS025R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5			
MWAT040R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5			
control	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	1.633	2.132	0.0073

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.81451	0.781	-0.6847	-0.2143
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.35)	1	2.30601		

Hypothesis Test (1-tail, 0.05)

Heteroscedastic t Test indicates no significant differences

Dose-Response Plot



ToxCalc v5.0.15N

Neanthes 20-day Growth Test-20-day Survival

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWRC209R1	1.0000	1.0000	1.0000	0.8000	1.0000
MWAS022R1	0.4000	1.0000	1.0000	1.0000	0.8000
MWAS024R1	0.8000	1.0000	1.0000	1.0000	1.0000
MWAS025R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT040R1	1.0000	1.0000	1.0000	1.0000	1.0000
control	1.0000	0.8000	1.0000	0.8000	1.0000

Comparisons made against reference sediment MWRC208R1.

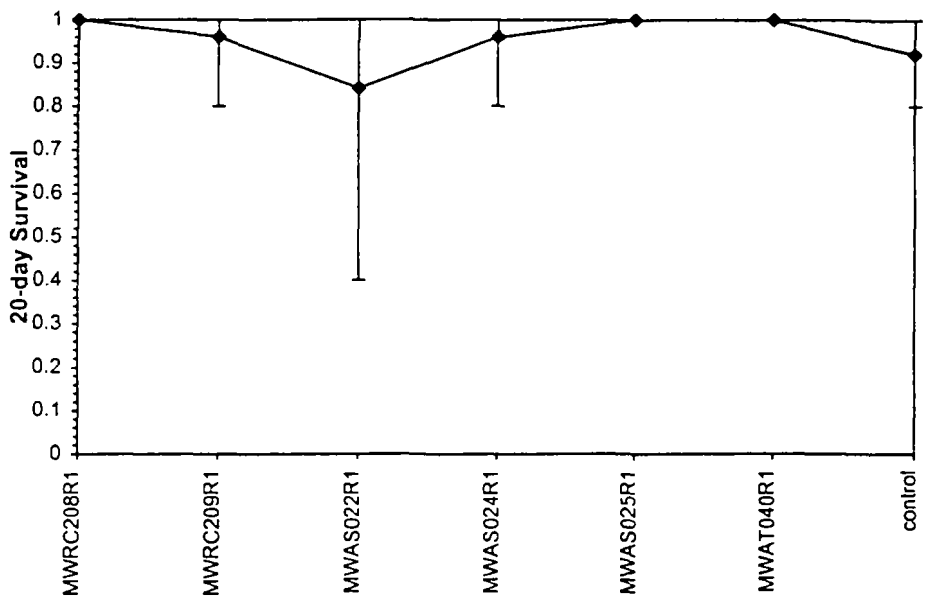
			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
MWRC208R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5		
MWRC209R1	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
MWAS022R1	0.8400	0.8750	1.1655	0.6847	1.3453	24.700	5		
MWAS024R1	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5		
MWAS025R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5	27.50	19.00
MWAT040R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5	27.50	19.00
control	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5		

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	1	0.781		
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.35)	1	2.30601		

Hypothesis Test (1-tail, 0.05)

Wilcoxon Two-Sample Test indicates no significant differences

Dose-Response Plot



ToxCalc v5.0.15N

Neanthes 20-day Growth Test-20-day Survival

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWRC209R1	1.0000	1.0000	1.0000	0.8000	1.0000
MWAS022R1	0.4000	1.0000	1.0000	1.0000	0.8000
MWAS024R1	0.8000	1.0000	1.0000	1.0000	1.0000
MWAS025R1	1.0000	1.0000	1.0000	1.0000	1.0000
MWAT040R1	1.0000	1.0000	1.0000	1.0000	1.0000
control	1.0000	0.8000	1.0000	0.8000	1.0000

Comparisons made against reference sediment MWRC209R1.

			Transform: Arcsin Square Root						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5			
MWRC209R1	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5			
MWAS022R1	0.8400	0.8750	1.1655	0.6847	1.3453	24.700	5	0.962	1.860	0.0350
MWAS024R1	0.9600	1.0000	1.2977	1.1071	1.3453	8.207	5	0.000	1.860	0.0084
MWAS025R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5	-1.000	2.132	0.0048
MWAT040R1	1.0000	1.0417	1.3453	1.3453	1.3453	0.000	5	-1.000	2.132	0.0048
control	0.9200	0.9583	1.2500	1.1071	1.3453	10.434	5	0.632	1.860	0.0105

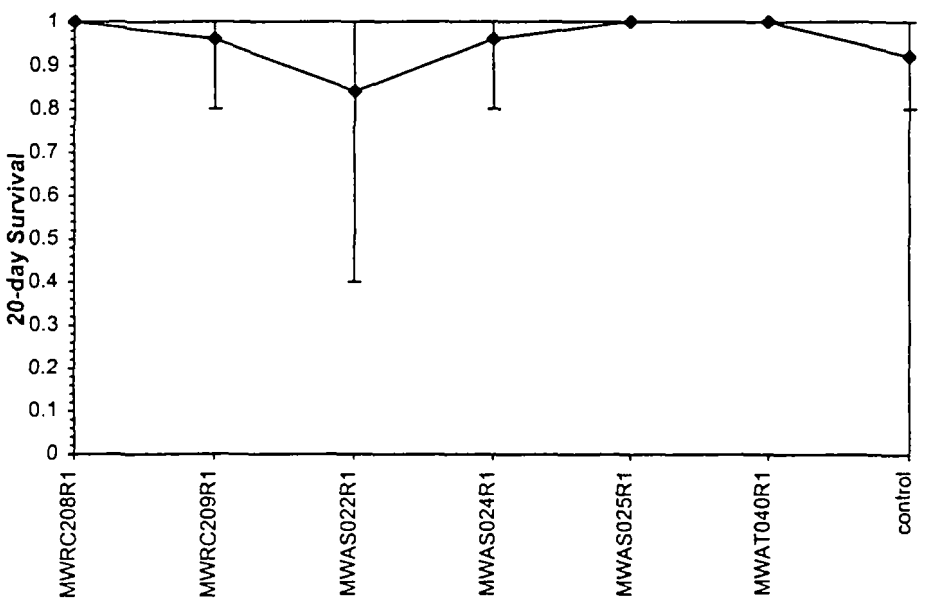
} heteroscedastic t-test
MLR 8-14-98

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.75876	0.781	-0.9546	-1.0157
F-Test indicates equal variances (p = 0.70)	1.5	23.1539		
The control means are not significantly different (p = 0.35)	1	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates no significant differences

Dose-Response Plot



ToxCalc v5.0.15N

Neanthes 20-day Growth Test-Average Biomass/Worm (mg)

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	13.752	9.190	9.354	10.892	13.804
MWRC209R1	7.710	10.088	6.406	8.183	12.238
MWAS022R1	15.490	11.362	13.250	9.642	13.155
MWAS024R1	12.510	7.924	7.238	9.922	10.038
MWAS025R1	8.612	6.312	5.866	6.924	4.854
MWAT040R1	8.292	8.732	7.650	9.558	9.160
control	12.160	17.800	14.808	10.185	14.388

Comparisons made to reference sediment MWRC208R1.

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	11.398	1.2771	11.398	9.190	13.804	19.928	5			
MWRC209R1	8.925	1.0000	8.925	6.406	12.238	25.490	5			
MWAS022R1	12.580	1.4095	12.580	9.642	15.490	17.490	5	-0.835	1.860	3.719
MWAS024R1	9.526	1.0674	9.526	7.238	12.510	21.720	5	1.362	1.860	3.511
* MWAS025R1	6.514	0.7298	6.514	4.854	8.612	21.419	5	4.097	1.860	2.643
* MWAT040R1	8.678	0.9724	8.678	7.650	9.558	8.575	5	2.544	1.860	2.125
control	13.868	1.5539	13.868	10.185	17.800	20.741	5	-1.507	1.860	4.996

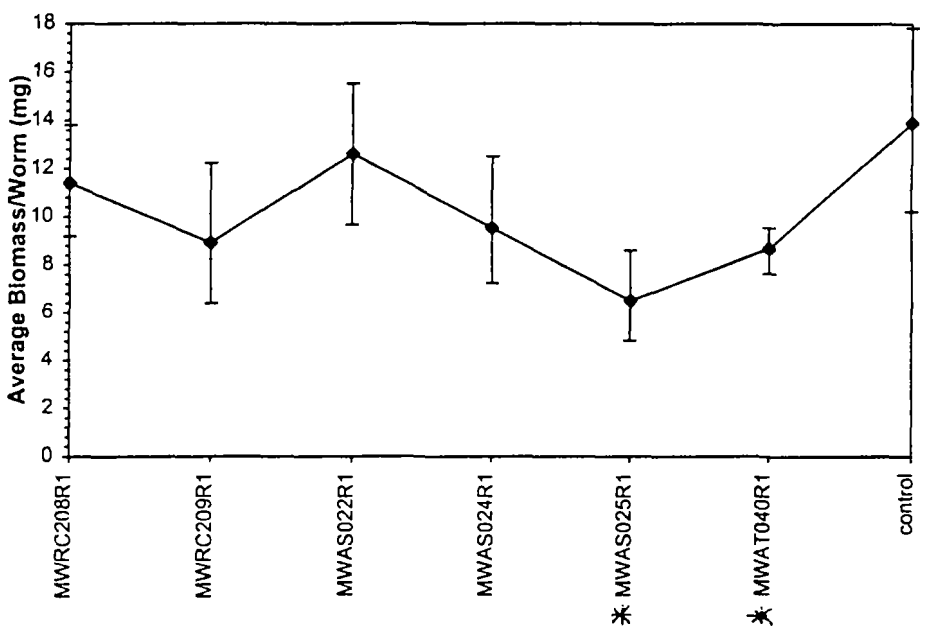
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96349	0.781	0.13628	-1.0462
F-Test indicates equal variances (p = 0.66)	1.60355	23.1539		
The control means are not significantly different (p = 0.12)	1.72043	2.30601		

Hypothesis Test (1-tail, 0.05) as generated by ToxCalc.

Homoscedastic t Test indicates ~~no~~ significant differences } This statement corresponds to the last comparison only (control vs. 208R1)

MLR 8-14-98 — MLR 8-14-98

Dose-Response Plot



* = significantly different from reference MWRC208R1.

ToxCalc v5.0.15N

Neanthes 20-day Growth Test Average Biomass/Worm (mg)

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	13.752	9.190	9.354	10.892	13.804
MWRC209R1	7.710	10.088	6.406	8.183	12.238
MWAS022R1	15.490	11.362	13.250	9.642	13.155
MWAS024R1	12.510	7.924	7.238	9.922	10.038
MWAS025R1	8.612	6.312	5.866	6.924	4.854
MWAT040R1	8.292	8.732	7.650	9.558	9.160
control	12.160	17.800	14.808	10.185	14.388

Comparisons made against reference MWRC209R1.

			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	11.398	1.2771	11.398	9.190	13.804	19.928	5			
MWRC209R1	8.925	1.0000	8.925	6.406	12.238	25.490	5			
MWAS022R1	12.580	1.4095	12.580	9.642	15.490	17.490	5	-2.582	1.860	3.725
MWAS024R1	9.526	1.0674	9.526	7.238	12.510	21.720	5	-0.437	1.860	3.517
* MWAS025R1	6.514	0.7298	6.514	4.854	8.612	21.419	5	2.020	1.860	2.649
MWAT040R1	8.678	0.9724	8.678	7.650	9.558	8.575	5	0.230	1.860	2.131
control	13.868	1.5539	13.868	10.185	17.800	20.741	5	-3.014	1.860	5.002

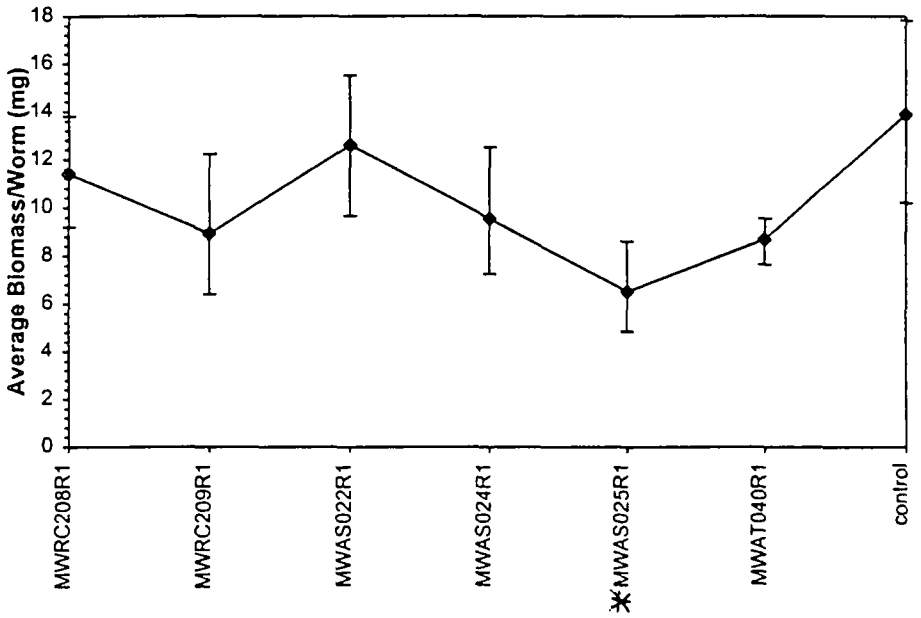
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96854	0.781	0.25239	-0.69
F-Test indicates equal variances (p = 0.66)	1.59875	23.1539		
The control means are not significantly different (p = 0.12)	1.72043	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates ~~no~~ significant differences } This statement generated by software to refer to the last comparison made MSR 8-14-98

MSR 8-14-98

Dose-Response Plot



*significantly different from reference MWRC209R1

ToxCalc v5.0.15N

Neanthes 20-day Growth Test-Individual Growth Rate

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.6787	0.4506	0.4588	0.5357	0.6813
MWRC209R1	0.3766	0.4955	0.3114	0.4002	0.6030
MWAS022R1	0.7656	0.5592	0.6536	0.4732	0.6489
MWAS024R1	0.6166	0.3873	0.3530	0.4872	0.4930
MWAS025R1	0.4217	0.3067	0.2844	0.3373	0.2338
MWAT040R1	0.4057	0.4277	0.3736	0.4690	0.4491
control	0.5991	0.8811	0.7315	0.5004	0.7105

Comparisons made to reference sediment MWRC208R1.

			Transform: Untransformed					1-Tailed		
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.5610	1.2828	0.5610	0.4506	0.6813	20.245	5			
MWRC209R1	0.4373	1.0000	0.4373	0.3114	0.6030	26.009	5			
MWAS022R1	0.6201	1.4179	0.6201	0.4732	0.7656	17.741	5	-0.835	1.860	0.0093
MWAS024R1	0.4674	1.0688	0.4674	0.3530	0.6166	22.133	5	1.362	1.860	0.0088
* MWAS025R1	0.3168	0.7243	0.3168	0.2338	0.4217	22.021	5	4.097	1.860	0.0066
* MWAT040R1	0.4250	0.9718	0.4250	0.3736	0.4690	8.755	5	2.544	1.860	0.0053
control	0.6845	1.5651	0.6845	0.5004	0.8811	21.011	5	-1.507	1.860	0.0125

Auxillary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96349	0.781	0.13628	-1.0462
F-Test indicates equal variances (p = 0.66)	1.60355	23.1539		
The control means are not significantly different (p = 0.12)	1.72043	2.30601		

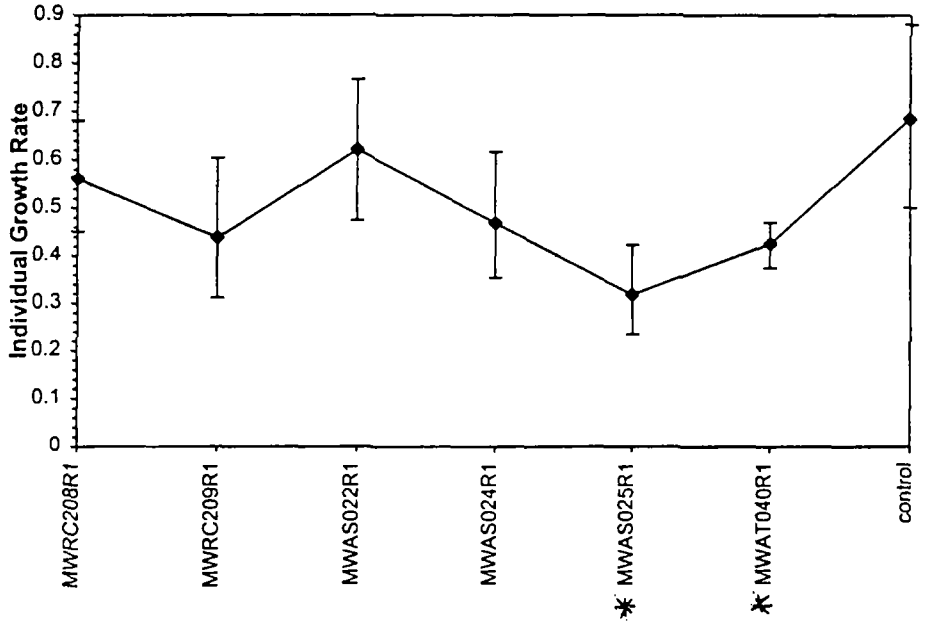
Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates ~~no~~ significant differences

This statement, as generated by ToxCalc, only refers to the last comparison

MLR 8-14-98

Dose-Response Plot



* significantly different from reference MWRC208R1.

ToxCalc v5.0.15N

Neanthes 20-day Growth Test-Individual Growth Rate

Start Date:	7/3/98 16:00	Test ID:	590-4	Sample ID:	
End Date:	7/23/98 14:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	SED-Sediment
Sample Date:		Protocol:	PSEP 1995-Puget Sound	Test Species:	NA-Neanthes arenaceodentata
Comments:					

Conc-	1	2	3	4	5
MWRC208R1	0.6787	0.4506	0.4588	0.5357	0.6813
MWRC209R1	0.3766	0.4955	0.3114	0.4002	0.6030
MWAS022R1	0.7656	0.5592	0.6536	0.4732	0.6489
MWAS024R1	0.6166	0.3873	0.3530	0.4872	0.4930
MWAS025R1	0.4217	0.3067	0.2844	0.3373	0.2338
MWAT040R1	0.4057	0.4277	0.3736	0.4690	0.4491
control	0.5991	0.8811	0.7315	0.5004	0.7105

Comparisons made to reference sediment MWRC209R1.

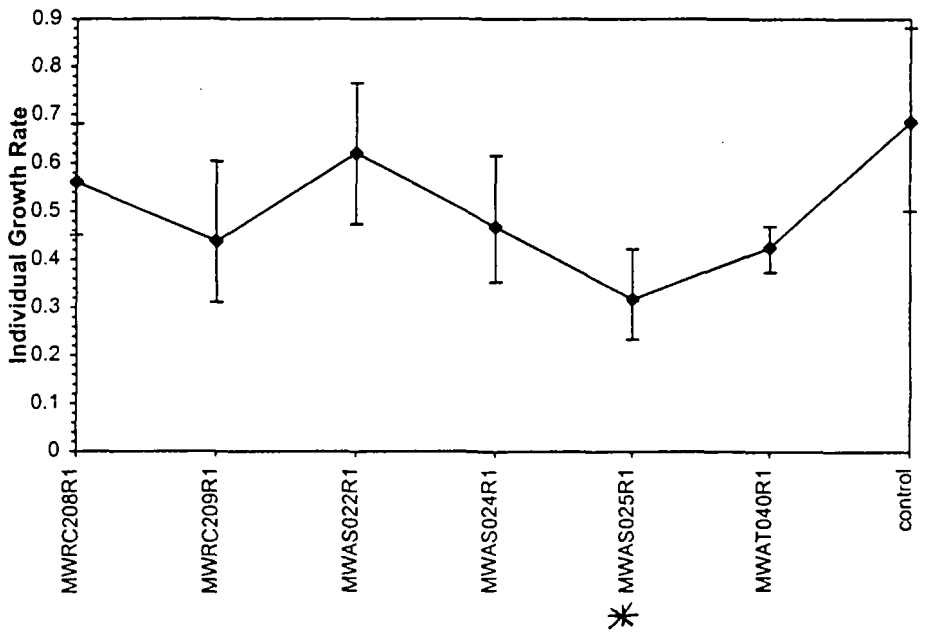
			Transform: Untransformed						1-Tailed	
Conc-	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
MWRC208R1	0.5610	1.2828	0.5610	0.4506	0.6813	20.245	5			
MWRC209R1	0.4373	1.0000	0.4373	0.3114	0.6030	26.009	5			
MWAS022R1	0.6201	1.4179	0.6201	0.4732	0.7656	17.741	5	-2.582	1.860	0.0093
MWAS024R1	0.4674	1.0688	0.4674	0.3530	0.6166	22.133	5	-0.437	1.860	0.0088
* MWAS025R1	0.3168	0.7243	0.3168	0.2338	0.4217	22.021	5	2.020	1.860	0.0066
MWAT040R1	0.4250	0.9718	0.4250	0.3736	0.4690	8.755	5	0.230	1.860	0.0053
control	0.6845	1.5651	0.6845	0.5004	0.8811	21.011	5	-3.014	1.860	0.0125

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96854	0.781	0.25239	-0.69
F-Test indicates equal variances (p = 0.66)	1.59875	23.1539		
The control means are not significantly different (p = 0.12)	1.72043	2.30601		

Hypothesis Test (1-tail, 0.05)

Homoscedastic t Test indicates ~~no~~ significant differences (This statement, as generated by ToxCalc, only refers to the last comparison) MSR 8-14-98

Dose-Response Plot



* significantly different from reference MWRC209R1.

ToxCalc v5.0.15N

Test: NS-Neanthes 20-day Growth Test
Test ID: 590-4
Species: NA-Neanthes arenaceodentata
Protocol: PSEP 1995-Puget Sound
Sample ID:
Sample Type: SED-Sediment
Start Date: 7/3/98 16:00 End Date: 7/23/98 14:00
Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Day 0	Day 20	Proportion Survived	INIT WT (mg)	FINAL WT (mg)	TARE WT (mg)	WT COUNT	TWT	WT	GR	Notes
	1	1	MWRC208R1	5	5	1	0.178	128.88	60.12	5	68.76	13.752	0.6787	
	2	2	MWRC208R1	5	5	1	0.178	107.83	61.88	5	45.95	9.19	0.4506	
	3	3	MWRC208R1	5	5	1	0.178	108.07	61.3	5	46.77	9.354	0.4588	
	4	4	MWRC208R1	5	5	1	0.178	114.28	59.82	5	54.46	10.892	0.5357	
	5	5	MWRC208R1	5	5	1	0.178	127.12	58.1	5	69.02	13.804	0.6813	
	6	1	MWRC209R1	5	5	1	0.178	108.59	70.04	5	38.55	7.71	0.3766	
	7	2	MWRC209R1	5	5	1	0.178	111.23	60.79	5	50.44	10.088	0.4955	
	8	3	MWRC209R1	5	5	1	0.178	96.99	64.96	5	32.03	6.406	0.3114	
	9	4	MWRC209R1	5	4	0.8	0.178	94.61	61.88	4	32.73	8.1825	0.400225	
	10	5	MWRC209R1	5	5	1	0.178	123.66	62.47	5	61.19	12.238	0.603	
	11	1	MWAS022R1	5	2	0.4	0.178	88.7	57.72	2	30.98	15.49	0.7656	
	12	2	MWAS022R1	5	5	1	0.178	114.16	57.35	5	56.81	11.362	0.5592	
	13	3	MWAS022R1	5	5	1	0.178	132.33	66.08	5	66.25	13.25	0.6536	
	14	4	MWAS022R1	5	5	1	0.178	109.11	60.9	5	48.21	9.642	0.4732	
	15	5	MWAS022R1	5	4	0.8	0.178	113.74	61.12	4	52.62	13.155	0.64885	
	16	1	MWAS024R1	5	4	0.8	0.178	108.28	58.24	4	50.04	12.51	0.6166	
	17	2	MWAS024R1	5	5	1	0.178	106.36	66.74	5	39.62	7.924	0.3873	
	18	3	MWAS024R1	5	5	1	0.178	99.63	63.44	5	36.19	7.238	0.353	
	19	4	MWAS024R1	5	5	1	0.178	109.29	59.68	5	49.61	9.922	0.4872	
	20	5	MWAS024R1	5	5	1	0.178	116.29	66.1	5	50.19	10.038	0.493	
	21	1	MWAS025R1	5	5	1	0.178	108.95	65.89	5	43.06	8.612	0.4217	
	22	2	MWAS025R1	5	5	1	0.178	94.08	62.52	5	31.56	6.312	0.3067	
	23	3	MWAS025R1	5	5	1	0.178	97.11	67.78	5	29.33	5.866	0.2844	
	24	4	MWAS025R1	5	5	1	0.178	96.32	61.7	5	34.62	6.924	0.3373	
	25	5	MWAS025R1	5	5	1	0.178	82.44	58.17	5	24.27	4.854	0.2338	
	26	1	MWAT040R1	5	5	1	0.178	109.18	67.72	5	41.46	8.292	0.4057	
	27	2	MWAT040R1	5	5	1	0.178	105.18	61.52	5	43.66	8.732	0.4277	
	28	3	MWAT040R1	5	5	1	0.178	105.15	66.9	5	38.25	7.65	0.3736	
	29	4	MWAT040R1	5	5	1	0.178	109.84	62.05	5	47.79	9.558	0.469	
	30	5	MWAT040R1	5	5	1	0.178	106.2	60.4	5	45.8	9.16	0.4491	
	31	1	control	5	5	1	0.178	123.77	62.97	5	60.8	12.16	0.5991	
	32	2	control	5	4	0.8	0.178	130.9	59.7	4	71.2	17.8	0.8811	
	33	3	control	5	5	1	0.178	138.18	64.14	5	74.04	14.808	0.7315	
	34	4	control	5	4	0.8	0.178	102.2	61.46	4	40.74	10.185	0.50035	
	35	5	control	5	5	1	0.178	131.29	59.35	5	71.94	14.388	0.7105	

Comments:

Water Quality Data

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3							
1	1024F	control	6	0	20.3	7.0	29.0	7.9	<0.02	0.2							
2	0750F	MRWC209R1	4	0	20.3	7.0	28.5	8.0			Mean	20.4	6.8	28.5	8.1	—	—
3	0690F	MWAS022R1	2	0	20.3	7.0	29.0	7.9			SD	0.2	0.3	0.6	0.2	—	—
4	0749F	MWRC208R1	6	0	20.3	7.1	29.0	8.1	<0.02	2.0	n	126	126	126	126	14	55
5	0749F	MWRC208R1	5	0	20.3	7.1	29.0	8.1			Max	20.7	7.2	30.0	8.6	<0.02	8.0
6	0692F	MWAS025R1	4	0	20.3	7.0	29.0	7.9			Min	20.0	5.9	27.0	7.7	<0.02	0.2
7	0721F	MWAT040R1	2	0	20.4	7	29	7.9									
9	0692F	MWAS025R1	2	0	20.3	7	29	8									
10	0750F	MWRC209R1	6	0	20.4	7	29	8.2	<0.02	1.5							
11	0721F	MWAT040R1	6	0	20.1	7	29	8.1	<0.02	2.4							
12	0692F	MWAS025R1	6	0	20.2	7	29	8.1	<0.02	3.6							
14	0691F	MWAS024R1	2	0	20.2	7	29	8									
15	0721F	MWAT040R1	3	0	20.2	7	29	7.7									
16	0749F	MWRC208R1	2	0	20.3	7	29	8.1									
17	1024F	control	1	0	20.2	7	29	8.1									
18	0721F	MWAT040R1	1	0	20.1	7	29	8									
19	0690F	MWAS022R1	4	0	20.3	7.1	29	8.1									
20	0692F	MWAS025R1	1	0	20	7	29	8.1									
22	0691F	MWAS024R1	3	0	20.3	7	29	7.8									
23	0692F	MWAS025R1	5	0	20.3	6.8	29	7.8									
25	1024F	control	2	0	20.4	6.8	29	8									
26	0749F	MWRC208R1	3	0	20.3	6.9	29	8									
27	0750F	MWRC209R1	3	0	20.2	7	29	8									
29	0691F	MWAS024R1	6	0	20.3	7	29	7.9	<0.02	2.8							
32	0692F	MWAS025R1	3	0	20.3	7.2	29	8									
33	0750F	MWRC209R1	1	0	20.3	7	29	8.1									
34	1024F	control	4	0	20.3	7	29	8.1									
35	0749F	MWRC208R1	1	0	20.3	7	29	8									
36	1024F	control	5	0	20.3	7	29	8									
37	0691F	MWAS024R1	4	0	20.3	7	29	8									
39	0749F	MWRC208R1	4	0	20.2	7	29	8.1									
40	0690F	MWAS022R1	3	0	20.4	7	28.5	7.9									
41	0721F	MWAT040R1	4	0	20.3	7	29	8									
42	0750F	MWRC209R1	5	0	20.3	6.9	29	7.8									
44	0691F	MWAS024R1	5	0	20.3	7	29	8									
45	0690F	MWAS022R1	1	0	20.3	7	29	8									
46	0750F	MWRC209R1	2	0	20.4	7	29	8.1									
50	1024F	control	3	0	20.4	6.9	29	7.9									
51	0721F	MWAT040R1	5	0	20.3	6.9	29	7.8									
53	0690F	MWAS022R1	5	0	20.3	6.9	29	7.8									
54	0690F	MWAS022R1	6	0	20.4	6.8	29	7.9	<0.02	1.2							
56	0691F	MWAS024R1	1	0	20.3	6.8	29	7.8									
4	0749F	MWRC208R1	6	3	20.3	6.3	30	7.7		1.5							
10	0750F	MWRC209R1	6	3	20.4	5.9	29	7.9		4							
11	0721F	MWAT040R1	6	3	20.4	6.7	29	7.9		0.5							
12	0692F	MWAS025R1	6	3	20.3	6.5	29	8		2							
29	0691F	MWAS024R1	6	3	20.3	7	29	8.3		1.5							
54	0690F	MWAS022R1	6	3	20.4	6	29	7.7		0.5							
1	1024F	control	6	3	20.3	5.9	30	7.7		0.5							
4	0749F	MWRC208R1	6	6	20.4	6.2	29	8.1		1							
10	0750F	MWRC209R1	6	6	20.4	6.6	28	8.1									
11	0721F	MWAT040R1	6	6	20.3	6.5	28	8		0.4							
12	0692F	MWAS025R1	6	6	20.3	6.7	29	8.3		5							
29	0691F	MWAS024R1	6	6	20	6.7	27.5	8.6		1							
54	0690F	MWAS022R1	6	6	20.4	6	28	7.8		1							
1	1024F	control	6	6	20.4	6.5	29	7.9		4.2							
4	0749F	MWRC208R1	6	9	20.4	6.2	28.5	7.9		5							
10	0750F	MWRC209R1	6	9	20.4	6.2	27.5	8.1		8							
11	0721F	MWAT040R1	6	9	20.3	6.3	28.5	7.9		0.8							
12	0692F	MWAS025R1	6	9	20.3	6.7	29	8.1		2							

Data entry verified by LK Nemeth 8-13-98
TNSR 8-14-98.

BKR	NAS SMPL	CLIENT DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3
29	0691F	MWAS024R1	6	9	20.2	6.9	29	8.5		2.8
54	0690F	MWAS022R1	6	9	20.4	6.2	28.5	7.7		1
1	1024F	control	6	9	20.4	6.4	28	7.7		4.2
4	0749F	MWRC208R1	6	12	20.4	6.7	28	8		1.6
10	0750F	MWRC209R1	6	12	20.4	6.6	28	8.4		6.5
11	0721F	MWAT040R1	6	12	20.3	6.7	28	8		0.8
12	0692F	MWAS025R1	6	12	20.3	6.7	28	8.3		4
29	0691F	MWAS024R1	6	12	20.2	6.8	29	8.5		3
54	0690F	MWAS022R1	6	12	20.4	6.4	28	8		2
1	1024F	control	6	12	20.4	6.7	28	8		2.8
4	0749F	MWRC208R1	6	15	20.5	6.5	28	7.7		0.5
10	0750F	MWRC209R1	6	15	20.6	6.8	28	7.9		3
11	0721F	MWAT040R1	6	15	20.5	6.4	28	7.8		0.5
12	0692F	MWAS025R1	6	15	20.5	6.6	28	8.1		4.5
29	0691F	MWAS024R1	6	15	20.5	6.6	29	8.4		0.5
54	0690F	MWAS022R1	6	15	20.7	6.2	28	7.9		2.5
1	1024F	control	6	15	20.5	6.4	28	7.7		7.5
4	0749F	MWRC208R1	6	18	20.6	7	28	7.9		0.4
10	0750F	MWRC209R1	6	18	20.6	7.2	28	8.1		0.6
11	0721F	MWAT040R1	6	18	20.7	7.1	28	8.2		0.2
12	0692F	MWAS025R1	6	18	20.6	7.1	28	8		4.2
29	0691F	MWAS024R1	6	18	20.6	7.2	29	8.2		0.2
54	0690F	MWAS022R1	6	18	20.5	7.2	27.5	8.5		2.5
1	1024F	control	6	18	20.6	6.9	27	8		4.4
1	1024F	control	6	20	20.5	6.6	28	8	<0.02	4
2	0750F	MRWC209R1	4	20	20.5	6.7	28	8.2		
3	0690F	MWAS022R1	2	20	20.5	6.7	28	8.2		
4	0749F	MWRC208R1	6	20	20.6	6.6	28	8.2	<0.02	0.2
5	0749F	MWRC208R1	5	20	20.6	6.8	28	8.2		
6	0692F	MWAS025R1	4	20	20.4	6.7	29	8.5		
7	0721F	MWAT040R1	2	20	20.7	7.1	28	7.9		
9	0692F	MWAS025R1	2	20	20.5	6.7	28	8.4		
10	0750F	MWRC209R1	6	20	20.6	7	28	8.3	<0.02	0.2
11	0721F	MWAT040R1	6	20	20.6	6.9	27	8.1	<0.02	0.2
12	0692F	MWAS025R1	6	20	20.5	6.8	28	8.3	<0.02	0.4
14	0691F	MWAS024R1	2	20	20.5	7	28	8.5		
15	0721F	MWAT040R1	3	20	20.4	6.9	28	8.1		
16	0749F	MWRC208R1	2	20	20.5	6.9	28	8.3		
17	1024F	control	1	20	20.5	6.9	28	8.2		
18	0721F	MWAT040R1	1	20	20.5	6.9	28	8.1		
19	0690F	MWAS022R1	4	20	20.5	7	28	8.1		
20	0692F	MWAS025R1	1	20	20.5	7	28	8.4		
22	0691F	MWAS024R1	3	20	20.7	6.9	28	8.3		
23	0692F	MWAS025R1	5	20	20.5	6.6	28	8.5		
25	1024F	control	2	20	20.6	7	28	8.2		
26	0749F	MWRC208R1	3	20	20.5	6.9	28	8.2		
27	0750F	MWRC209R1	3	20	20.5	6.9	28	8.4		
29	0691F	MWAS024R1	6	20	20.5	7	29	8.6	<0.02	0.2
32	0692F	MWAS025R1	3	20	20.5	6.9	28	8.5		
33	0750F	MWRC209R1	1	20	20.5	6.8	28	8.3		
34	1024F	control	4	20	20.6	7	28	8.2		
35	0749F	MWRC208R1	1	20	20.6	6.9	28	8.2		
36	1024F	control	5	20	20.6	6.9	28	8.2		
37	0691F	MWAS024R1	4	20	20.6	6.8	28	8.6		
39	0749F	MWRC208R1	4	20	20.6	6.8	28	8.1		
40	0690F	MWAS022R1	3	20	20.7	7	28	8.1		
41	0721F	MWAT040R1	4	20	20.6	6.8	28	8.1		
42	0750F	MWRC209R1	5	20	20.6	6.7	28	8.3		
44	0691F	MWAS024R1	5	20	20.6	7	28	8.5		
45	0690F	MWAS022R1	1	20	20.6	7	28	8.2		
46	0750F	MWRC209R1	2	20	20.6	6.9	28	8.4		
50	1024F	control	3	20	20.7	6.8	28	8.1		

	NAS	CLIENT																
BKR	SMPL	DESCRIP	REPL	DAY	TEMP	DO	SAL	pH	S	NH3								
51	0721F	MWAT040R1	5	20	20.6	7	28	8.1										
53	0690F	MWAS022R1	5	20	20.6	7	28	8.1										
54	0690F	MWAS022R1	6	20	20.6	6.9	28	8	<0.02	2								
56	0691F	MWAS024R1	1	20	20.7	6.8	28	8.2										

~~700~~

20/day

You ordered 650

adjustments to be made
in billing

Thanks,

Chain of Custody Record
Request for Analysis

Page 1 of 1 Lab. Ref. No. _____

FW FOSTER WHEELER ENVIRONMENTAL CORPORATION
10900 NE 8th Street • Bellevue, WA 98004
(206) 688-3700 • Fax (206) 688-3952

Project Name: Middle WATERWAY
Project Address: 10900 NE 8th St. Bellevue, WA 98004
FW Project No.: 1699.0010.0005

Sampling Date: 5-22-98
Shipping Date:
Shipping Ref.:

Analysis Laboratory: Northwestern Aquatic Sciences
Laboratory Contact: Dick Caldwell P.O. No.:
Reports to be Sent to: Gary Braun
Address/Phone No.: 425-688-3700 Fax 425-688-3951

Sampler(s): (printed name) D. Brent Jones
Sampler(s): (signature) D. Brent Jones
Special Instructions:

Hazard ID:
[X] Nonhazardous
[ ] Hazardous:
[ ] Reactive
[ ] Toxic
[ ] Flammable
[ ] Irritant
[ ] Infectious
[ ] Radioactive

Sample Disposal Instructions:
[X] Lab disposal
[ ] Return to FWENC
[ ] Hold for pickup (will call)

ANALYSES REQUEST (circle appropriate method number)

SAMPLE IDENTIFICATION	TIME COLLECTED	NO OF CONTAINERS, SIZE & TYPE	PRESERVATIVE	MATRIX	SAMPLE TYPE Composite	SAMPLE TYPE Grab	Method Standard	EXTRACTION	TCLP (1311)	Other	CLP Data Pkg.: Other	Halogenated Volatiles 8010, 601, 502.1, CLP	Aromatic Volatiles 8020, 602, 502.2, 503.1, CLP	BETX Only 8020, 602, CLP	GC/MS Vol. 8240, 8260, 624, 524.1, 524.2, CLP	GC/MS BNA (semi-vol.) 8250, 8270, 625, 525, CLP	Pesticides & PCBs 8080, 8081, 608, 505, 508, CLP	PCBs Only 8080, 608, 508A, CLP	HPLC PNA/PAHs 8310, 610	Ordnance/Explosives HPLC 8330 mod. GC/ECD	TPH-HCID AK, OR, WA, 418.1	TPH-G AK, OR, WA, 8015 mod	TPH-D AK, OR, WA, 8015 mod	Lead 6010, 7420, 7421	Priority Poll. Metals (13) 6010 & 7000 Series CLP	TCL Metals (23) 6010 & 7000 Series, CLP	TCLP 1311 (metals, VOAs, SVOAs, Pest., Herb.)	BIOASSAY (AS PER Contract)	REMARKS
~~208RC~~ DBJ	1445	(6) 32oz glass																											
MWRC208R1 DBJ	1520		none	Sediment	X				NAC #					0749	F												X		cool to 4°C
MWRC209R1	1530													0750	F												X		
MWRC210R1	1600													0751	F												X		

Turnaround Time:
[X] Standard
[ ] 1 Week
[ ] 72 Hours
[ ] 48 Hours
[ ] 24 Hours
[ ] Other

Sample Receipt:
Total # Containers Recvd:
COC Seals Present?
COC Seals Intact?
Received Cold?
Received Intact?
Received Via:

Relinquished by: (signature) D. Brent Jones
Date: 5/22/98 Time:
Received by: (signature) David Johnson
Date: 5-28-98 Time: 10:30

Relinquished by: (signature)
Date: Time:
Received by: (signature)
Date: Time:

Relinquished by: (signature)
Date: Time:
Received by: (signature)
Date: Time:

Relinquished by: (signature)
Date: Time:
Received by: (signature)
Date: Time:

ADM409—10/96

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Page 1 of 1 Lab. Ref. No.

Chain of Custody Record

FOSTER WHEELER ENVIRONMENTAL CORPORATION
10900 NE 8th Street • Bellevue, WA 98004
(206) 688-3700 • Fax (206) 688-3952

~~Alaska Pulp Corporation~~
~~Bay OU RI/FS Studies~~
~~Sitka, Alaska~~ Middle Waterway

FW Project No.: ~~1442-2000-2000~~ 1697.0010.0006

Sampling Date: 5/15/98
Shipping Date: 5/16/98
Shipping Ref.:

Analytical Laboratory: ~~Columbia Analytical Services (360-577-7222)~~ NW Aquatic
Laboratory Contact: ~~Abbie Spielman~~ P.O. No.:
Reports to be Sent to: ~~Brenda Steele (FW)~~ Kata Ritenburg
Address/Phone No.: ~~206-688-3849~~ 425-688-3700

Sampler(s): (printed name) CAROL HUTZEY
Sampler(s). (signature) Carol Hutzey
Special Instructions:

SAMPLE IDENTIFICATION	TIME COLLECTED	NO OF CONTAINERS, SIZE & TYPE	PRESERVATIVE	MATRIX	SAMPLE TYPE Composite	SAMPLE TYPE Grab	Dioxins/Furans 8290	Metals PSEP 6010/7000/200.8 (As,Ba,Cd,Cr,Pb,Se,Ag,Cu,Mn,Ni,Zn)	Sediment Conventionals PSEP Methods (Total Solids,Total Sulfides,Acid Volatiles Sulfides,TOC, Ammonia as Nitrogen,Grain Size,BOD,COD)	Guaiacols EPA 1653	Resin Acids, Fatty Acids, Bleach Plant Derivatives NCASI RA/FA-85.01 mod.	Lipids	Bioassays Suite in Contract for MW Project Amphipod + Echinoderm Hold for possible Neanthes	REMARKS
MWA5024R1	11:00	6-32 oz.	None	Sed	X								✓	NAS# 0691F
MWA5025R1	14:37	6-32 oz	None	Sed	X								✓	0692F
MWA5022R1	16:10	6-32 oz	None	Sed	X								✓	0690F

Turnaround Time:
[ ] Standard
[ ] 1 Week
[ ] 4 Work Day
[ ] 3 Work Day
[ ] 2 Work Day
[ ] 24 Hour

Sample Receipt
Total # Containers Recvd: 18
COC Seals Present? NO
COC Seals Intact?
Received Cold? Yes
Received Intact? Yes
Received Via: FedEx

Relinquished by: (signature) Carol Hutzey
Date: 5/15/98 Time: 22:05
Received by: (signature) N. C. Caldwell
Date: 5/18/98 Time: 15:00

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

Relinquished by: (signature) Date: Time:
Received by: (signature) Date: Time:

-54-

MultiChem ANALYTICAL SERVICES

1960 Nadeau Ave SW Suite 101 Renton WA 98055
(800) 609-0580 • (425) 228-8335 • FAX (425) 228-8336

LAB NUMBER:

DATE: 5/18/98

PAGE: 1 of 1

COMPANY: Foster Wheeler Envr
ADDRESS: 10900 NE 8th St Ste 1300
Bellevue, WA

PHONE: (425) 688 3700 FAX (425) 688 3952
PROJ. MGR / CONTACT: Kala Rutenberg
PROJECT NUMBER: 1699.0010.0006
PROJECT NAME:
DISPOSAL: ☐ MAS ☑ HOLD ☐ RETURN

SAMPLE ID	DATE	TIME	MATRIX	LAB ID		FUELS										ORGANIC COMPOUNDS								METALS					TCLP					OTHER					
MWAT054RI 5-32 oz	5/18/98	11:51	Sed	0723	F																													Biassay per Contract					
MWAT049RI 5-32 oz	5/18/98	13:50	Sed	0722	F																																		
MWAT040RI 5-32 oz	5/18/98	17:30	Sed	0721	F																																		

SAMPLE RECEIPT			TAT
TOTAL # OF CONTAINERS	☐ YES	☐ NO	☐ 24 HOURS
COC SEALS PRESENT?	☐ YES	☒ NO	☐ 48 HOURS
COC SEALS INTACT?	☐ YES	☐ NO	☐ 72 HOURS
RECEIVED COLD?	☒ YES	☐ NO	☐ STATS
RECEIVED INTACT?	☒ YES	☐ NO	☐ [illegible]
RECEIVED VIA: Fed Ex			☐ [illegible]

SPECIAL REPORTING REQUIREMENTS:
Amphipod larvae --> Hold Sed for possible Neanthes

METALS NEEDED:

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
SIGNATURE: Carol Hutley	SIGNATURE:	SIGNATURE:
PRINT NAME: CAROL HUTLEY	PRINT NAME:	PRINT NAME:
DATE: 5/19/98 TIME: 11:40	DATE: TIME:	DATE: TIME:
COMPANY:	COMPANY:	COMPANY:
RECEIVED BY:	**RECEIVED BY:**	**RECEIVED BY:**
SIGNATURE: [signature]	SIGNATURE:	SIGNATURE:
PRINT NAME: Richard S. Caldwell	PRINT NAME:	PRINT NAME:
DATE: 5/20/98 TIME: 15:20	DATE: TIME:	DATE: TIME:
COMPANY: NW Aquatic	COMPANY:	COMPANY:

MAS USE ONLY: SUBCONTRACT LAB: PO #:

-55-

APPENDIX III

RAW DATA - REFERENCE TOXICANT TEST

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-918 Client QC Test Investigator

Test Type (rangefinding/definitive) Test Length (hr) 96

Species Neanthes sp.

STUDY MANAGEMENT

Client: QC Test

Client's Study Monitor: NA

Testing Laboratory: Northwestern Aquatic Sciences

Test Location: Newport Laboratory

Laboratory's Study Personnel:

Proj. Man./Study Dir. R.S. Caldwell

QA Officer L.K. Nemeth

1. G.J. IRISSARRI GJI 2. Erin Loftey

3. 4.

Study Schedule:

Test Beginning: 7-3-98 1600 Test Ending: 7-7-98 1700

TEST MATERIAL

Description: cadmium as $CdCl_2 \cdot 2\frac{1}{2} H_2O$, Mallinckrodt Lot TNZ

NAS Sample No.: 1.0 mg/ml stocked prepared 6-23-98

Date of Collection:

Date of Receipt:

Temperature (°C):

Dissolved oxygen (mg/L):

Conductivity (umhos/cm):

pH:

Hardness (mg/L):

Alkalinity (mg/L):

:

DILUTION WATER

Description: Yaquina Bay seawater

Date of Preparation/Collection: 7-2-98

Water Quality: Cond. (umhos/cm) — Salinity (ppt) 28.0 pH 7.7

Hardness (mg/L as $CaCO_3$) — Alkalinity (mg/L as $CaCO_3$) —

Treatments: filtered to <0.4um, AERATED, SALINITY ADJUSTED w/ D.I. WATER (MILLI-Q)

TEST ORGANISMS

Species: Neanthes sp. Age: Size: RECEIVED 7-1-98

Source: DEPT OF BIOLOGY, CALIF STATE UNIV., LONG BEACH, CA

Acclimation Data:

Date	Temp (°C)	DO (mg/L)	pH	Sal/Cond	Comments
7-1-98	21.1	6.5	7.5	34.0	RECEIVING WATER
7-2-98	20.0	6.7	7.9	30.0	
7-3-98	19.9	5.4	7.6	30.5	
Mean					
S.D.					
(N)					

Rev. 2/97

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-918 Client QC Test Investigator _____

TEST PROCEDURES AND CONDITIONS

Test concentrations: (50% series recommended) 25, 12.5, 6.25, 3.13, 1.56 and Ø mg/L

Test chambers: 600 mL glass beakers Test volume: 500 mL

Replicates/treatment: (2) 2 Organisms/treatment: (20) 20 (10/repl.)

Test water changes: none Aeration during test: none

Feeding: None Photoperiod: constant light

Temperature: 20 ± 1

Duration: 24-hr, 48-hr, 96-hr Renewal: none

Beaker placement: Stratified randomization

Randomization chart:

A	1.56	25	Ø	6.25	3.13	12.5
B	25	12.5	1.56	3.13	Ø	6.25
C						
D						

MISCELLANEOUS NOTES

Test solution preparation:

Conc (mg/L)	mL of 1.0 mg/mL stock per 500 mL
25	12.5
12.5	6.3
6.25	3.1
3.13	1.6
1.56	0.8
Ø	Ø

7-3-98

NORTHWESTERN AQUATIC SCIENCES PROTOCOL NO. NAS-

ACUTE TOXICITY TEST (ALL SPECIES)

Test No. 999-918 Client QC test Investigator

DAY 0 (7/13/98) [illegible]

Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1. 25	20.2	7.2	27.5		7.9			10	10
2. 12.5	20.2	7.2	27.5		7.9			10	10
3. 6.25	20.2	7.2	27.5		7.8			10	10
4. 3.13	20.3	7.2	28.0		7.8			10	10
5. 1.56	20.3	7.2	27.5		7.8			10	10
6. Ø	20.3	7.2	28.0		7.7			10	10

DAY 1 (7/14/98) [illegible]

Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1. 25	20.6	7.0	28.0		7.7			6(4D)	9(6D)
2. 12.5	20.6	7.0	28.0		7.7			8(2D)	9(1D)
3. 6.25	20.5	7.0	28.0		7.7			10	10
4. 3.13	20.6	7.0	28.0		7.7			10	10
5. 1.56	20.6	7.1	28.0		7.7			10	10
6. Ø	20.6	7.0	28.0		7.6			9(1m)	10

DAY 2 (7/15/98) [illegible]

Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1. 25	20.2	6.7	27.0		7.9			0(6D)	0(4D)
2. 12.5	20.3	6.7	28.0		7.9			0(3D)	2(7D)
3. 6.25	20.2	6.6	28.0		7.9			9(1M)	10
4. 3.13	20.2	6.7	28.5		7.9			10	10
5. 1.56	20.2	6.7	29.0		7.9			10	10
6. Ø	20.2	6.6	29.0		7.9			9(1D)	10

DAY 3 (7/16/98) [illegible]

Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1. 25	—	—	—		—			0	0
2. 12.5	—	—	—		—			0	0
3. 6.25	20.4	6.6	28.0		7.9			9	9(1D)
4. 3.13	20.5	6.7	28.0		7.9			10	10
5. 1.56	20.4	6.6	28.0		7.9			10	10
6. Ø	20.4	6.5	28.0		7.9			10	10

DAY 4 (7/17/98) [illegible]

Conc. (mg/L)	Temp. (°C)	DO (mg/L)	Sal. (ppt)	Cond. (umh/cm)	pH	Hard. (mg/L)	Alk. (mg/L)	Survivors A	Survivors B
1. 25								0	0
2. 12.5								0	0
3. 6.25	20.5	6.6	28.0		7.8			7(2D)	8(1D)
4. 3.13	20.5	6.6	28.0		7.8			10	10
5. 1.56	20.5	6.6	28.0		7.9			10	10
6. Ø	20.6	6.6	27.5		7.8			10	10

Remarks:

Rev. 2/97

Acute 96-hr Toxicity Test-96 Hr Survival

Start Date:	7/3/98 16:00	Test ID:	999-918	Sample ID:	REF-Ref Toxicant
End Date:	7/7/98 17:00	Lab ID:	ORNAS-Northwestern Aquat	Sample Type:	CDCL-Cadmium chloride
Sample Date:		Protocol:	EPAA 91-EPA Acute	Test Species:	NA-Neanthes arenaceodentata
Comments:					

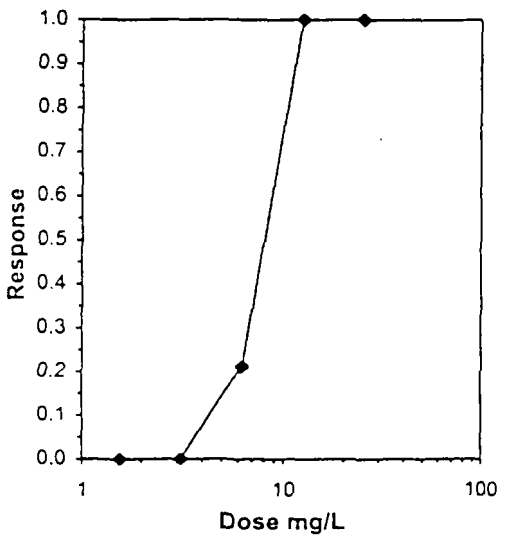
Conc-mg/L	1	2
D-Control	1.0000	1.0000
1.56	1.0000	1.0000
3.13	1.0000	1.0000
6.25	0.7778	0.8000
12.5	0.0000	0.0000
25	0.0000	0.0000

			Transform: Arcsin Square Root					Number	Total
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Numbe.
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
1.56	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
3.13	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	2	0	20
6.25	0.7889	0.7889	1.0935	1.0799	1.1071	1.761	2	4	19
12.5	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20
25	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	2	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Normality of the data set cannot be confirmed				
Equality of variance cannot be confirmed				

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	7.6400	6.7119	8.6964
5.0%	7.7856	6.7168	9.0245
10.0%	7.9118	6.6163	9.4611
20.0%	8.0568	5.9317	10.9432
Auto-0.0%	7.6400	6.7119	8.6964



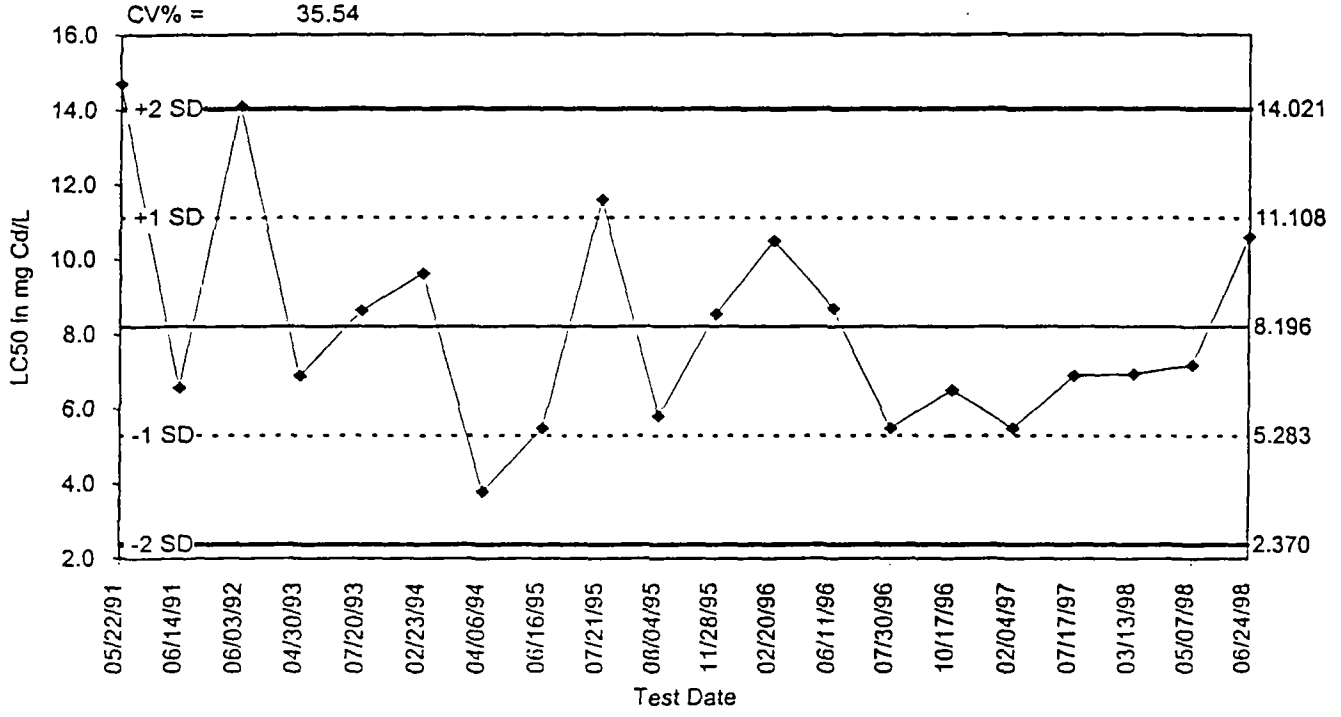
ToxCalc v5.0.15N

Test: AT-Acute 96-hr Toxicity Test	Test ID: 999-918
Species: NA-Neanthes arenaceodentata	Protocol: EPAA 91-EPA Acute
Sample ID: REF-Ref Toxicant	Sample Type: CDCL-Cadmium chloride
Start Date: 7/3/98 16:00 End Date: 7/7/98 17:00	Lab ID: ORNAS-Northwestern Aquatic Sciences

Pos	ID	Rep	Group	Start	24 Hr	48 Hr	72 Hr	96 Hr	Notes
	1	1	D-Control	10				10	
	2	2	D-Control	10				10	
	3	1	1.560	10				10	
	4	2	1.560	10				10	
	5	1	3.130	10				10	
	6	2	3.130	10				10	
	7	1	6.250	9				7	
	8	2	6.250	10				8	
	9	1	12.500	10				0	
	10	2	12.500	10				0	
	11	1	25.000	10				0	
	12	2	25.000	10				0	

Comments:

Control Chart for Neanthes sp. 96-hr Reference Toxicant Test - last 20 points



7-20-98

ToxCalc v4.0

700

20/bag

you ordered 650

adjustments to be made
in billing

Thanks,

RAW BENTHIC DATA

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES CHECKLIST
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

Phylum Cnidaria
- Class Anthozoa
  - Anthozoa sp. Indeterminate

Phylum Nemertea
- Nemertea sp. Indeterminate

Phylum Annelida
- Class Polychaeta
  - Order Orbiniida
    - Family Orbiniidae
      - Leitoscoloplos sp. Juvenile
  - Order Spionida
    - Family Spionidae
      - Boccardia proboscidea Hartman, 1940
      - Dipolydora caulleryi (Mesnil, 1897)
      - Polydora cornuta Bosc, 1802
      - Polydora sp. Juvenile
      - Prionospio (Minuspio) lighti Maceolek, 1985
      - Pseudopolydora kempi (Southern, 1921)
      - Pygospio elegans Claparede, 1863
      - Spio filicornis Muller, 1776
      - Spionidae sp. Juvenile
      - Spiophanes berkeleyorum Pettibone, 1962
      - Streblospio benedicti Webster, 1879
    - Family Cirratulidae
      - Cirratulidae sp. Indeterminate
      - Tharyx parvus Berkeley, 1929
  - Order Capitellida
    - Family Capitellidae
      - Capitella capitata 'hyperspecies'
      - Capitellidae sp. Indeterminate
      - Heteromastus filobranchus Berkeley & Berkeley, 1932
      - Mediomastus sp. Indeterminate
      - Notomastus (Clistomastus) tenuis Moore, 1909
    - Family Arenicolidae
      - Aberinicola sp. Indeterminate
  - Order Opheliida
  - Order Phyllodocida
    - Family Phyllodocidae
      - Eteone sp. Indeterminate
      - Eumida longicornuta (Moore, 1909)
      - Phyllodoce sp. Indeterminate
    - Family Hesionidae
      - Podarkeopsis glabra (Hartmann-Schroder, 1959)
    - Family Syllidae
      - Syllis sp. Indeterminate

Family Nereidae
Nereis vexillosa Grube, 1851
Nereis virens (Sars, 1835)
Platynereis bicanaliculata (Baird, 1863)
Family Glyceridae
Glycera americana Leidy, 1855
Glycera nana Johnson, 1901
Glycera sp. Juvenile
Family Goniadidae
Glycinde polygnatha Hartman, 1950
Order Eunicida
Family Lumbrineridae
Lumbrineris sp. Indeterminate
Order Sabellida
Family Sabellidae
Manayunkia aestuarina (Bourne, 1883)
Class Oligochaeta
Oligochaeta sp. Indeterminate
Phylum Mollusca
Class Bivalvia
Bivalvia sp. Juvenile
Order Mytiloida
Family Mytilidae
Mytilis sp. Juvenile
Order Veneroida
Family Lasaeidae
Rochefortia tumida (Carpenter, 1864)
Family Tellinidae
Macoma balthica (Linnaeus, 1758)
Macoma inquinata (Deshayes, 1855)
Macoma nasuta (Conrad, 1837)
Macoma sp. Indeterminate
Macoma sp. Juvenile
Order Myoida
Family Myidae
Cryptomya californica (Conrad, 1837)
Phylum Arthropoda
Class Insecta
Order Diptera
Family Chironomidae
Chironomidae sp. Juvenile
Subphylum Crustacea
Order Harpacticoida
Harpacticoida sp. Indeterminate
Order Cumacea
Family Leuconidae
Leucon subnasica Given, 1962
Family Nannastacidae
Cumella vulgaris Hart, 1930
Order Tanaidacea
Family Tanaidae
Zeuxo normani (Richardson, 1905)

Order Isopoda
Family Limnoriidae
Limnoria lignorum (Rathke, 1799)
Order Amphipoda
Family Anisogammaridae
Eogammarus confervicolus (Stimpson, 1856)
Family Aoroidae
Grandidierella japonica Stephensen, 1938
Family Corophiidae
Corophiidae sp. Indeterminate
Monocorophium sp. Juvenile
Monocorophium insidiosium Bousfield & Hoover, 1997
Order Decapoda
Family Crangonidae
Crangon sp. Indeterminate
Family Upogebiidae
Upogebiidae sp. Indeterminate
Family Grapsidae
Hemigrapsus oregonensis (Dana, 1851)
Phylum Phoronida
Family Phoronidae
Phoronida sp. Indeterminate
Phylum Echinodermata
Class Holothuroidea
Holothuroidea sp. Indeterminate

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	Station	MWBT 039				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100	1	1	1		2
Boccardia proboscidea	5001430803		1		7	
Capitella capitata 'hyperspecies'	5001600101	43	43	26	45	32
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000	1	1	3		3
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200	6	12	4		7
Eumida longicornuta						
Glycera americana	5001270104					
Glycera nana					1	
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105	1				
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502	20	55	49	24	20
Mediomastus sp. Indet.	5001600400					1
Nereis vexillosa	5001240405					
Nereis virens	5001240302	1				
Notomastus tenuis	5001600302					
Oligochaeta sp. Indet.		58	23	32	17	29
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411	1	1			
Polydora sp. Juv.	5001430400				1	
Prionospio lighti	5001430521					
Pseudopolydora kempi	5001431501	5	8	2	6	3
Pygospio elegans	5001431302	9	5	20	6	6
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					1
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801					
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303		2		1	
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101			1		
Macoma balthica	5515310116	1		2	5	1
Macoma inquinata	5515310115		1			
Macoma nasuta	5515310114	1		1		
Macoma sp. Indet.	5515310100					
Macoma sp. Juv.	5515310100	3	1	2		
Mytilus sp. Juv.	5507010100					
Rochefortia tumida	5515100102					

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	Station	MWBT 039				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118					
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	4	3	2		2
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102		2			3
Eogammarus confervicolus						
Grandidierella japonica	6169150902					6
Hemigrapsus oregonensis	6189070102					
Harpacticoida sp. Indet.	6119000000	4		1		5
Leucon subnasica	6154040115	1	1			5
Limnora lignorum	6161050101				1	
Monocorophium insidiosum	6169150211	5		5	3	11
Monocorophium sp. Juv.	6169150200					
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani						
Miscellaneous						
Anthozoa sp. Indet.	3740000000					
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000					
Nemertinea sp. Indet.	4300000000					1
Phoronida sp. Indet.	7700000000					

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	Station	**MWBT** 043				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100		1	1	1	1
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	21	39	53	25	34
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000	4	4	4	8	
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200	10	5	5	3	
Eumida longicornuta						
Glycera americana	5001270104	2	2		2	4
Glycera nana						
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105		1		2	
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502		4	11		3
Mediomastus sp. Indet.	5001600400	2	4	2	4	4
Nereis vexillosa	5001240405					
Nereis virens	5001240302					
Notomastus tenuis	5001600302					
Oligochaeta sp. Indet.		43	56	54	44	56
Phyllodoce sp. Indet.	5001131400	1				
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411			1		
Polydora sp. Juv.	5001430400					
Prionospio lighti	5001430521		2			
Pseudopolydora kempi	5001431501	6	9	13	11	13
Pygospio elegans	5001431302	8	16	21	2	25
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004		1			1
Streblospio benedicti	5001431801					
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303	3	2	1	10	1
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101					
Macoma balthica	5515310116	1	5	4	1	
Macoma inquinata	5515310115				1	
Macoma nasuta	5515310114	4	1		1	1
Macoma sp. Indet.	5515310100			1		
Macoma sp. Juv.	5515310100					
Mytilus sp. Juv.	5507010100					
Rochefortia tumida	5515100102					

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	Station	**MWBT** 043				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118					
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	1	3	8	5	3
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102	1	3	2	2	1
Eogammarus confervicolus						
Grandidierella japonica	6169150902	7	15	8	13	6
Hemigrapsus oregonensis	6189070102					
Harpacticoida sp. Indet.	6119000000	2	2	8		
Leucon subnasica	6154040115	12	22	18	12	18
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	15	21	19	24	27
Monocorophium sp. Juv.	6169150200		1		2	3
Upogebiidae sp. Indet.	6183170000			1		
Zeuzo normani						
Miscellaneous						
Anthozoa sp. Indet.	3740000000					
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000					
Nemertinea sp. Indet.	4300000000		1			
Phoronida sp. Indet.	7700000000					

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		Station	**MWBT**				
			048				
		Rep	A	B	C	D	E
TAXON	NODC CODE						
POLYCHAETA							
Aberinicola sp. Indet.	5001620100			6	5	2	4
Boccardia proboscidea	5001430803						
Capitella capitata 'hyperspecies'	5001600101		62	68	17	47	22
Capitellidae sp. Indet.	5001600000						
Cirratulidae sp. Indet.	5001500000		2	4		3	4
Dipolydora caulleryi	5001430404						
Dipolydora socialis	5001430402						
Eteone sp. Indet.	5001130200		4	12	8	6	3
Eumida longicornuta							
Glycera americana	5001270104		1				2
Glycera nana							
Glycera sp. Juv.	5001270100						
Glycinde polygnatha	5001280105				1	1	2
Heteromastus filobranchus	5001600203						
Leitoscoloplos sp. Juv.	5001401600						
Lumbrineris sp. Indet.	5001310100						
Manyunkia aestuarina	5001701502		20	8		12	6
Mediomastus sp. Indet.	5001600400			1	1	1	1
Nereis vexillosa	5001240405						
Nereis virens	5001240302						
Notomastus tenuis	5001600302						
Oligochaeta sp. Indet.			31	343	144	140	109
Phyllodoce sp. Indet.	5001131400						
Platynereis bicanaliculata	5001240501						
Podarkeopsis glabrus	5001211903						
Polydora cornuta	5001430411		2	2	1		
Polydora sp. Juv.	5001430400					1	
Prionospio lighti	5001430521						
Pseudopolydora kempi	5001431501		8	21	18	22	19
Pygospio elegans	5001431302		14	17	9	11	17
Spio filicornis	5001430701						
Spionidae sp. Juv.	5001430000				1		
Spiophanes berkeleyorum	5001431004						
Streblospio benedicti	5001431801						
Syllis sp. Indet.	5001230300						
Tharyx parvus	5001500303					1	1
Mollusca							
Bivalvia sp. Juv.	5500000000						
Cryptomya californica	5517010101					1	
Macoma balthica	5515310116		1	1	1	1	
Macoma inquinata	5515310115				1		
Macoma nasuta	5515310114		2	4	3	4	6
Macoma sp. Indet.	5515310100						
Macoma sp. Juv.	5515310100			2			1
Mytilus sp. Juv.	5507010100						1
Rochefortia tumida	5515100102						1

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		Station	**MWBT**				
			048				
		Rep	A	B	C	D	E
TAXON	NODC CODE						
Crustacea							
Ampithoe lacertosa	6169040118						
Cirripedia sp. Indet.	6130000000		1				1
Corophiidae sp. Indet.	6169150000		4	5	1	4	3
Crangon sp. Indet.	6179220100						
Cumella vulgaris	6154080102			26	1	7	7
Eogammarus confervicolus							
Grandidierella japonica	6169150902		8	14	12	15	3
Hemigrapsus oregonensis	6189070102						
Harpacticoida sp. Indet.	6119000000		3	4		1	2
Leucon subnasica	6154040115		4	76	46	65	55
Limnora lignorum	6161050101						
Monocorophium insidiosum	6169150211		15	2	6	6	9
Monocorophium sp. Juv.	6169150200			4	1	1	
Upogebiidae sp. Indet.	6183170000						
Zeuzo normani							
Miscellaneous							
Anthozoa sp. Indet.	3740000000						
Chironomidae sp. Indet.							
Holothuroidea sp. Juv.	8170000000						2
Nemertinea sp. Indet.	4300000000						
Phoronida sp. Indet.	7700000000		1				

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	Station	**MWBT** 049				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100	12	7	6	5	7
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	38	9	36	36	35
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000		2	1		1
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402			1		
Eteone sp. Indet.	5001130200	9	10	4	4	13
Eumida longicornuta						
Glycera americana	5001270104				1	
Glycera nana			7			
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105	1				
Heteromastus filobranchus	5001600203					1
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502	75	10	23	75	65
Mediomastus sp. Indet.	5001600400					
Nereis vexillosa	5001240405					
Nereis virens	5001240302					1
Notomastus tenuis	5001600302			1	1	
Oligochaeta sp. Indet.		92	47	32	69	61
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411	3	1	3	5	5
Polydora sp. Juv.	5001430400					
Prionospio lighti	5001430521					
Pseudopolydora kempi	5001431501	6	11	3	1	6
Pygospio elegans	5001431302	11	19	11	19	20
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801					
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303					
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101					
Macoma balthica	5515310116		2	2	1	
Macoma inquinata	5515310115					
Macoma nasuta	5515310114				1	
Macoma sp. Indet.	5515310100					
Macoma sp. Juv.	5515310100					
Mytilus sp. Juv.	5507010100					
Rochefortia tumida	5515100102					

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	Station	MWBT 049				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118		1		2	
Cirripedia sp. Indet.	6130000000			1		2
Corophiidae sp. Indet.	6169150000	3	4	3	3	9
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102	1	1	3	3	1
Eogammarus confervicolus						
Grandidierella japonica	6169150902	1		5	2	
Hemigrapsus oregonensis	6189070102	1				
Harpacticoida sp. Indet.	6119000000	1	1	1	1	1
Leucon subnasica	6154040115	6	1	19	30	10
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	31	13	15	12	22
Monocorophium sp. Juv.	6169150200			4	3	6
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani		6	4	1	8	9
Miscellaneous						
Anthozoa sp. Indet.	3740000000				1	
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000	4	1		3	6
Nemertinea sp. Indet.	4300000000	1		2	1	2
Phoronida sp. Indet.	7700000000					

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	Station	**MWBT** 052				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100	1		2	10	4
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	56	60	141	171	174
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000	1		2		1
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200	9	3	10	5	16
Eumida longicornuta						
Glycera americana	5001270104		1	1		
Glycera nana		1			1	
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105			2		3
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502	31	17	105	38	79
Mediomastus sp. Indet.	5001600400				1	1
Nereis vexillosa	5001240405			1		
Nereis virens	5001240302					
Notomastus tenuis	5001600302	2				1
Oligochaeta sp. Indet.		81	31	99	43	62
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411				1	1
Polydora sp. Juv.	5001430400					
Prionospio lighti	5001430521					
Pseudopolydora kempi	5001431501	9	4	5	13	6
Pygospio elegans	5001431302	5		1	2	4
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801					
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303		1			
Mollusca						
Bivalvia sp. Juv.	5500000000			1		
Cryptomya californica	5517010101					
Macoma balthica	5515310116	1	2			
Macoma inquinata	5515310115					
Macoma nasuta	5515310114	3	4	2	4	3
Macoma sp. Indet.	5515310100					
Macoma sp. Juv.	5515310100					1
Mytilus sp. Juv.	5507010100					
Rochefortia tumida	5515100102					

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	Station	**MWBT** 052				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118					
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	2	3	4	3	12
Crangon sp. Indet.	6179220100				1	
Cumella vulgaris	6154080102	6	1	8	1	12
Eogammarus confervicolus						
Grandidierella japonica	6169150902	4		7		3
Hemigrapsus oregonensis	6189070102					
Harpacticoida sp. Indet.	6119000000	1	1	10	4	15
Leucon subnasica	6154040115	10	6	9	3	13
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	9	4	15	5	21
Monocorophium sp. Juv.	6169150200	2		8		7
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani				6	1	
Miscellaneous						
Anthozoa sp. Indet.	3740000000				1	
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000		1	2		
Nemertinea sp. Indet.	4300000000				1	
Phoronida sp. Indet.	7700000000		1			

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	Station	MWBT 054				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100	1		1		1
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	37	17	38	21	26
Capitellidae sp. Indet.	5001600000	1				
Cirratulidae sp. Indet.	5001500000	2				
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200	14	13	14	13	9
Eumida longicornuta						
Glycera americana	5001270104					
Glycera nana						
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105					1
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502	165	63	111	120	35
Mediomastus sp. Indet.	5001600400					1
Nereis vexillosa	5001240405					
Nereis virens	5001240302	1				
Notomastus tenuis	5001600302					
Oligochaeta sp. Indet.		37	13	37	25	75
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411			1		
Polydora sp. Juv.	5001430400					
Prionospio lighti	5001430521					
Pseudopolydora kempi	5001431501					
Pygospio elegans	5001431302	14	5	11	20	16
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801					
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303					
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101					
Macoma balthica	5515310116			1	1	
Macoma inquinata	5515310115	1				
Macoma nasuta	5515310114					
Macoma sp. Indet.	5515310100					
Macoma sp. Juv.	5515310100					
Mytilus sp. Juv.	5507010100	1				
Rochefortia tumida	5515100102					

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By Marine Taxonomic Services, Ltd.
August, 1998

	Station	**MWBT** 054				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118					
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	24	26	48	58	76
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102	1	1			2
Eogammarus confervicolus		2	6	1	8	11
Grandidierella japonica	6169150902	3	19	18	10	18
Hemigrapsus oregonensis	6189070102					
Harpacticoida sp. Indet.	6119000000	13	5	6	15	2
Leucon subnasica	6154040115	29	30	24	23	27
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	73	89	101	113	109
Monocorophium sp. Juv.	6169150200	16	28	23	20	31
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani		78	44	74	32	37
Miscellaneous						
Anthozoa sp. Indet.	3740000000					
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000	1				
Nemertinea sp. Indet.	4300000000					
Phoronida sp. Indet.	7700000000					

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES DATA
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

	Station	MWRH 205				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100		2	1		2
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	120	86	117	30	52
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000		5	5	3	3
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200	6	7	3	6	10
Eumida longicornuta			1			
Glycera americana	5001270104				2	
Glycera nana			1			
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105		2	1		1
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100	1	1			
Manyunkia aestuarina	5001701502	136	172	100	65	94
Mediomastus sp. Indet.	5001600400					
Nereis vexillosa	5001240405					
Nereis virens	5001240302				1	
Notomastus tenuis	5001600302			1		
Oligochaeta sp. Indet.		663	783	683	279	636
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501			1		
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411					
Polydora sp. Juv.	5001430400					
Prionospio lighti	5001430521					
Pseudopolydora kempi	5001431501	1	2	2	2	1
Pygospio elegans	5001431302	9	6	3	4	19
Spio filicornis	5001430701		1	1		
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801	8	14	10	9	8
Syllis sp. Indet.	5001230300	1				
Tharyx parvus	5001500303					2
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101					
Macoma balthica	5515310116			2	2	1
Macoma inquinata	5515310115					
Macoma nasuta	5515310114		2	2		
Macoma sp. Indet.	5515310100		1			
Macoma sp. Juv.	5515310100	1		1		
Mytilus sp. Juv.	5507010100			2		1
Rochefortia tumida	5515100102					

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES DATA
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

	Station	MWRH 205				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118	4	4	6	8	4
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	49	73	53	17	87
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102	5	3	2	1	3
Eogammarus confervicolus		1	1	6		
Grandidierella japonica	6169150902	19	9	8	1	4
Hemigrapsus oregonensis	6189070102				1	
Harpacticoida sp. Indet.	6119000000	54	19	24	8	42
Leucon subnasica	6154040115		2		4	3
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	85	91	76	66	85
Monocorophium sp. Juv.	6169150200	171	118	55	45	54
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani		123	132	76	58	101
Miscellaneous						
Anthozoa sp. Indet.	3740000000					
Chironomidae sp. Indet.		1				
Holothuroidea sp. Juv.	8170000000	12	10	7	7	11
Nemertinea sp. Indet.	4300000000		1			1
Phoronida sp. Indet.	7700000000					1

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES DATA
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

	Station	MWRH 206				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100	10	8	6	5	3
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	32	49	46	43	53
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000	1	8	3	4	1
Dipolydora caulleryi	5001430404		1	1		
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200	2	2		5	
Eumida longicornuta						1
Glycera americana	5001270104	1		2	1	1
Glycera nana						
Glycera sp. Juv.	5001270100				1	
Glycinde polygnatha	5001280105	1		2		
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600				1	
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502	18	17	13	3	6
Mediomastus sp. Indet.	5001600400	1			2	1
Nereis vexillosa	5001240405					
Nereis virens	5001240302					
Notomastus tenuis	5001600302					
Oligochaeta sp. Indet.		113	201	145	106	163
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903				1	
Polydora cornuta	5001430411				1	
Polydora sp. Juv.	5001430400		1	1		1
Prionospio lighti	5001430521			2		
Pseudopolydora kempi	5001431501	1	4	3	4	2
Pygospio elegans	5001431302	3	7	2	1	3
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801	17	33	42	24	38
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303			1		
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101					
Macoma balthica	5515310116					
Macoma inquinata	5515310115		1		1	
Macoma nasuta	5515310114	5	5	4	5	3
Macoma sp. Indet.	5515310100					
Macoma sp. Juv.	5515310100		1			
Mytilus sp. Juv.	5507010100					
Rochefortia tumida	5515100102					

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES DATA
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

	Station	**MWRH**				
		206				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118					
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	2	3	1	9	11
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102	3	2			1
Eogammarus confervicolus					1	4
Grandidierella japonica	6169150902				1	2
Hemigrapsus oregonensis	6189070102					
Harpacticoida sp. Indet.	6119000000		1		1	1
Leucon subnasica	6154040115	18	7	5	26	29
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	13	22	21	27	5
Monocorophium sp. Juv.	6169150200	5	12	2	6	15
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani					1	1
Miscellaneous						
Anthozoa sp. Indet.	3740000000					
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000	4		1	5	2
Nemertinea sp. Indet.	4300000000					
Phoronida sp. Indet.	7700000000					

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES DATA
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

	Station	MWRH 207				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
POLYCHAETA						
Aberinicola sp. Indet.	5001620100	11	12	10	8	18
Boccardia proboscidea	5001430803					
Capitella capitata 'hyperspecies'	5001600101	56	43	73	123	51
Capitellidae sp. Indet.	5001600000					
Cirratulidae sp. Indet.	5001500000	7	7	10	3	11
Dipolydora caulleryi	5001430404					
Dipolydora socialis	5001430402					
Eteone sp. Indet.	5001130200		4	1	5	2
Eumida longicornuta						
Glycera americana	5001270104		1			
Glycera nana						
Glycera sp. Juv.	5001270100					
Glycinde polygnatha	5001280105					
Heteromastus filobranchus	5001600203					
Leitoscoloplos sp. Juv.	5001401600					
Lumbrineris sp. Indet.	5001310100					
Manyunkia aestuarina	5001701502	50	51	47	117	47
Mediomastus sp. Indet.	5001600400					1
Nereis vexillosa	5001240405					
Nereis virens	5001240302					
Notomastus tenuis	5001600302	2				
Oligochaeta sp. Indet.		162	168	113	683	247
Phyllodoce sp. Indet.	5001131400					
Platynereis bicanaliculata	5001240501					
Podarkeopsis glabrus	5001211903					
Polydora cornuta	5001430411	2	2	5	1	
Polydora sp. Juv.	5001430400	2	2		7	
Prionospio lighti	5001430521					
Pseudopolydora kempi	5001431501	6	5	3	11	7
Pygospio elegans	5001431302	14	29	20	37	27
Spio filicornis	5001430701					
Spionidae sp. Juv.	5001430000					
Spiophanes berkeleyorum	5001431004					
Streblospio benedicti	5001431801	14	16	10	37	29
Syllis sp. Indet.	5001230300					
Tharyx parvus	5001500303	1		1	6	3
Mollusca						
Bivalvia sp. Juv.	5500000000					
Cryptomya californica	5517010101					
Macoma balthica	5515310116	1	4			1
Macoma inquinata	5515310115					
Macoma nasuta	5515310114			2	3	1
Macoma sp. Indet.	5515310100					
Macoma sp. Juv.	5515310100					
Mytilus sp. Juv.	5507010100					1
Rochefortia tumida	5515100102					

Tacoma Middle Waterway Project
INVERTEBRATE SPECIES DATA
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

	Station	MWRH 207				
	Rep	A	B	C	D	E
TAXON	NODC CODE					
Crustacea						
Ampithoe lacertosa	6169040118				1	2
Cirripedia sp. Indet.	6130000000					
Corophiidae sp. Indet.	6169150000	19	32	22	21	13
Crangon sp. Indet.	6179220100					
Cumella vulgaris	6154080102	2			2	
Eogammarus confervicolus		4	3	8	6	10
Grandidierella japonica	6169150902					8
Hemigrapsus oregonensis	6189070102					
Harpacticoida sp. Indet.	6119000000			2	2	
Leucon subnasica	6154040115	11	33	31	55	28
Limnora lignorum	6161050101					
Monocorophium insidiosum	6169150211	55	74	52	89	96
Monocorophium sp. Juv.	6169150200	25	33	8	20	13
Upogebiidae sp. Indet.	6183170000					
Zeuzo normani		1	4	1		
Miscellaneous						
Anthozoa sp. Indet.	3740000000					
Chironomidae sp. Indet.						
Holothuroidea sp. Juv.	8170000000	11	32	3	9	12
Nemertinea sp. Indet.	4300000000		1			1
Phoronida sp. Indet.	7700000000					

Tacoma Middle Waterway Project
BIOMASS MEASUREMENTS IN GRAMS
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

Station	Rep	Polys	Molluscs	Crustacea	Misc.
MWBT039R1	A	0.133	0.161	0.019	-----
	B	0.092	1.351	0.005	-----
	C	0.058	1.895	0.005	-----
	D	0.262	0.767	0.005	-----
	E	0.050	0.211	0.027	0.015
MWBT043R1	A	0.621	6.368	0.073	-----
	B	0.151	4.933	0.139	0.008
	C	0.167	3.588	0.077	-----
	D	0.149	4.854	0.108	-----
	E	0.230	0.070	0.067	-----
MWBT048R1	A	1.425	8.372	-----	-----
	B	0.276	11.117	0.077	-----
	C	0.254	17.407	0.064	-----
	D	0.323	5.721	0.090	-----
	E	0.175	7.324	0.053	0.001
MWBT049R1	A	0.333	0.519	0.104	0.002
	B	0.569	0.497	0.023	0.002
	C	0.219	0.721	0.046*	-----
	D	0.269	1.838	0.055	0.004
	E	0.339	-----	0.042*	0.016
MWBT052R1	A	0.239	3.529	0.028	-----
	B	0.093	9.277	0.009	0.001
	C	0.690	9.801	0.054	0.001
	D	0.306	10.643	0.007	-----
	E	0.354	6.407	0.047	-----
MWBT054R1	A	0.082	0.019	0.277	-----
	B	0.057	-----	0.265	-----
	C	0.057	0.430	0.250	-----
	D	0.057	0.057	0.253	-----
	E	0.070	-----	0.287	-----
MWRH205R1	A	0.230	0.005	0.319	0.008
	B	0.321	2.382	0.290	0.001
	C	0.320	5.700	0.280	0.013
	D	0.658	1.058	0.198	0.003
	E	0.275	0.244	0.345	0.006
MWRH206R1	A	0.295	7.262	0.038	0.002

Tacoma Middle Waterway Project
BIOMASS MEASUREMENTS IN GRAMS
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

Station	Rep	Polys	Molluscs	Crustacea	Misc.
	B	0.221	6.646	0.093	-----
	C	0.522	6.505	0.049	-----
	D	0.194	15.233	0.094	-----
	E	0.254	6.902	0.108	-----
MWRH207R1	A	0.312	1.074	0.121	0.004
	B	0.252	1.646	0.197	0.025
	C	0.188	1.388	0.138	0.002
	D	0.610	6.679	0.217	0.004
	E	0.682	3.096	0.337	0.007

*** Barnacles on shell not weighed**

Tacoma Middle Waterway Project

BULK QA REPORTS

For Foster Wheeler Environmental Corporation

By Marine Taxonomic Services, Ltd.

August, 1998

POLYCHAETA

STATION	ID by HRJ	Count	QA ID by ER	Count
MWRH206R1D	*Aberinicola sp. Indet.*	5		5
	Capitella capitata 'hyperspecies'	43		43
	Cirratulidae sp. Indet.	4		4
	Eteone sp. Indet.	5		5
	Glycera americana	1		1
	Glycera sp. Juv.	1		1
	Holothuroidea sp. Indet.	5		5
	Leitoscoloplos sp. Juv (complex??)	1	*Scoloplos acmeceps*	1
	Manyunkia aestuarina	3		4
	Mediomastus sp. Indet.	2		1
	Oligochaeta sp. Indet.	106		110
	Podarkeopsis glabrus	1		1
	Polydora cornuta	1		1
	Polydora kempi	4		4
	Pygospio elegans	1		1
	Streblospio benedicti	24		23

POLYCHAETA

STATION	ID by HRJ	Count	QA ID by ER	Count
MWRH207R1C	*Aberinicola sp. Indet.*	10		10
	Capitella capitata 'hyperspecies'	73		77
	Chaetozone acuta	1	*Tharyx parvus*	1
	Cirratulidae sp. Indet.	10		10
	Eteone sp. Indet.	1		1
	Manyunkia aestuarina	47		47
	Oligochaeta sp. Indet.	113		119
	Polydora cornuta	5		5
	Polydora kempi	3		3
	Pygospio elegans	20		20
	Streblospio benedicti	10		10

Tacoma Middle Waterway Project
BULK QA REPORTS
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

STATION	MOLLUSCA ID by SW	Count	QA ID by AF	Count
MWRH207R1B	*Macoma balthica*	4		4

STATION	MOLLUSCA ID by SW	Count	QA ID by AF	Count
MWBT039R1C	*Cryptomya californica*	1		1
	Macoma balthica	2		2
	Macoma nasuta	1		1
	Macoma sp. Juv.	2		2

Tacoma Middle Waterway Project

SORTING QA REPORT

For Foster Wheeler Environmental Corporation

By Marine Taxonomic Services, Ltd.

August, 1998

STATION	REP	COUNT POLYCHAETA	MOLLUSCA	CRUSTACEA	MISC	SORTER	P/NP
MWBT039R1	A	1	0	0	0	BB	P
	B	0	0	0	0	AT	P
	C	0	0	0	0	AT	P
	D	0	0	1	0	AT	P
	E	0	0	0	0	BB	P
MWBT043R1	A	0	0	0	0	BB	P
	B	0	0	0	0	BB	P
	C	1	0	0	0	AT	P
	D	0	0	0	0	AT	P
	E	0	0	0	0	AT	P
MWBT048R1	A	0	0	0	0	AT	P
	B	1	0	0	0	BB	P
	C	0	0	0	0	AT	P
	D	0	0	1	0	AT	P
	E	0	0	0	0	AT	P
MWBT049R1	A	0	0	0	0	AT	P
	B	0	0	0	0	BB	P
	C	0	0	0	0	AT	P
	D	0	0	0	0	AT	P
	E	0	0	0	0	AT	P
MWBT052R1	A	1	0	0	0	AT	P
	B	0	0	0	0	BB	P
	C	0	0	0	0	AT	P
	D	0	0	0	0	AT	P
	E	0	0	0	0	AT	P
MWBT054R1	A	1	0	1	0	BB	P
	B	0	0	0	0	BB	P
	C	0	0	0	0	BB	P
	D	0	0	0	0	BB	P
	E	0	0	0	0	AT	P
MWRH205R1	A	0	0	0	0	AT	P
	B	2	0	1	0	BB	P
	C	0	0	0	0	AT	P
	D	0	0	0	0	BB	P
	E	0	0	0	0	AT	P
MWRH206R1	A	0	0	0	0	AT	P
	B	0	0	0	0	AT	P
	C	0	0	0	0	BB	P
	D	0	0	0	0	AT	P
	E	0	0	0	0	AT	P
MWRH207R1	A	0	0	0	0	AT	P
	B	0	0	0	0	AT	P
	C	1	0	0	0	BB	P
	D	0	0	0	0	BB	P
	E	0	0	0	0	BB	P

Tacoma Middle Waterway Project
VOUCHER COLLECTION & QA REPORT
For Foster Wheeler Environmental Corporation
By Marine Taxonomic Services, Ltd.
August, 1998

POLYCHAETA

Vial #	Station		ID by HRJ	Count	QA ID by ER
1	MWBT	043R1B	*Aberinicola sp. Indet.*	1	ID Confirmed
2	MWBT	039R1B	*Boccardia proboscidea*	1	ID Confirmed
3	MWBT	043R1B	*Capitella capitata 'hyperspecies'*	1	ID Confirmed
4	MWRH	207R1C	*Chaetozone acuta*	1	*Tharyx parvus**
5	MWRH	205R1A	*Eteone sp. Indet.*	1	ID Confirmed
6	MWRH	205R1B	*Eumida longicornuta*	1	ID Confirmed
7	MWBT	043R1A	*Glycera americana*	1	ID Confirmed
8	MWBT	052R1A	*Glycera nana*	1	ID Confirmed
9	MWRH	206R1D	*?Leitoscoloplos sp. Juv.*	1	*Scoloplos acmeceps*
10	MWBT	043R1B	*Manyunkia aestarina*	1	ID Confirmed
11	MWBT	043R1B	*Mediomastus sp. Indet.*	1	ID Confirmed
12	MWBT	052R1A	*Notomastus tenuis*	1	ID Confirmed
13	MWRH	207R1E	*Oligochaeta sp. Indet.*	2	ID Confirmed
14	MWRH	206R1D	*Podarkeopsis glabrus*	1	ID Confirmed
15	MWRH	206R1B	*Dipolydora caulleryi*	1	ID Confirmed
16	MWRH	206R1D	*Polydora cornuta*	1	ID Confirmed
17	MWBT	043R1B	*Pseudopolydora kempi*	1	ID Confirmed
18	MWBT	043R1A	*Pygospio elegans*	1	ID Confirmed
19	MWRH	205R1B	*Spio filicornis*	1	ID Confirmed
20	MWBT	043R1B	*Spiophanes berkeleyorum*	1	ID Confirmed
21	MWRH	205R1A	*Streblospio benedicti*	1	ID Confirmed
22	MWRH	207R1A	*? Tharyx sp. Indet.*	1	*Tharyx parvus**

MOLLUSCA

Vial #	Station		ID by SW	Count	QA ID by AF
23	MWBT	048R1D	*Cryptomya californica*	1	ID Confirmed
24	MWRH	207R1A	*Macoma balthica*	1	ID Confirmed
25	MWBT	048R1C	*Macoma inquinata*	1	ID Confirmed
26	MWBT	048R1B	*Macoma nasuta*	1	ID Confirmed
27	MWBT	048R1E	*Macoma sp. Juv.*	1	ID Confirmed
28	MWRH	205R2E	*Mytilus sp. Juv.*	1	ID Confirmed
29	MWBT	048R1E	*Rochefortia tumida*	1	ID Confirmed

CRUSTACEA

Vial #	Station		ID by RZ	Count
	MWBT	049R1B	*Ampithoe lacertosa*	1
30	MWBT	048R1A	*Cirripedia sp. Indet.*	1
31	MWBT	039R1A	*Corophiidae sp. Indet.*	1
32	MWBT	052R1D	*Crangon sp. Indet.*	1
33	MWBT	039R1B	*Cumella vulgaris*	1
34	MWRH	206R1D	*Eogammarus confervicolus*	1
35	MWRH	205R1D	*Gnorimosphaeroma oregonensis*	1
36	MWBT	039R1E	*Grandidierella japonica*	1
37	MWBT	039R1A	*Harpacticoida sp. Indet.*	1
38	MWBT	049R1A	*Hemigraspsus oregonensis*	1
39	MWBT	039R1A	*Leucon subnasica*	1
40	MWBT	039R1D	*Limnoria lignorum*	1
41	MWBT	039R1A	*Monocorophium insidiosum*	1
42	MWBT	049R1D	*Monocorophium sp. Juv.*	1
43	MWBT	043R1C	*Upogebiidae sp. Indet.*	1
44	MWBT	049R1A	*Zeuxo normani*	1

***Changed globally in the data set**

APPENDIX H

APPENDIX H

APPENDIX H

PHYSICAL SURVEY REPORT

FINAL REPORT

FIELD METHODS, ACTIVITIES AND ANALYSIS

FOR

BATHYMETRIC, SIDE SCAN SONAR AND
SUB-BOTTOM PROFILING SURVEYS

OF THE
MIDDLE WATERWAY
ON COMMENCEMENT BAY

TACOMA, WA

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1.0 INTRODUCTION

Blue Water Engineering (BWE) was contracted by Hartman Consulting Corporation (HCC) to conduct bathymetric, side scan sonar and sub-bottom profiling surveys on the Middle Waterway on Commencement Bay in Tacoma, WA. The purpose of the surveys was to provide detailed baseline data for sediment remediation activities on the waterway.

2.0 FIELD METHODS

The bathymetric, side scan and sub-bottom surveys were conducted using industry standard methods of survey described below.

2.1 Positioning

Global positioning system (GPS) navigation was used for positioning the survey vessel during the automated bathymetric, side scan and sub-bottom surveys. The system used was a Trimble Model 4000 DS GPS receiver manufactured by Trimble Navigation, Inc. of Sunnyvale, CA. The GPS antenna was located on the port side of the survey vessel directly over the depth sounder transducer during the bathymetric and the side scan surveys. During the sub-bottom profiling survey the antenna was located on the starboard side of the survey vessel over the sub-bottom profiling transducer.

A Trimble ProBeacon Coast Guard differential corrections receiver was used to receive corrections to the GPS signals. Based on calibrations conducted at the site the average "on-the-fly" accuracy of the system was $\pm$ 1 meter.

On the survey vessel the GPS receiver sent differentially-corrected geographic coordinates once per second to an integrated navigation software package called HYPACK, a product of Coastal Oceanographics, Inc. of Middlefield, CT. The GPS receiver displayed and transmitted data to an on-board computer in North American Datum 1983 (NAD 83) geographic coordinates (latitude /longitude). HYPACK converted the NAD 83 geographic coordinates to NAD 83 Washington state plane coordinates - south zone. HYPACK, acting as a data manager, displayed the vessel's position relative to a proposed survey trackline in plan view on a video screen. The resultant pictorial screen presentation, as well as numeric navigation data, assisted the vessel operator in approaching and maintaining trackline bearing while surveying.

The positioning and depth sounder data were acquired and processed by HYPACK. The software was installed on a 80486 DX33 PC with a 245 Mb hard drive. During the bathymetric survey positioning and depth data were recorded on hard disk about once per second or

about every 5-8 ft depending on survey vessel speed. During the side scan sonar and sub-bottom profiling surveys positioning data were recorded at the same rate on the computer.

2.2 Bathymetry

2.2.1 Depth Sounder

During the automated survey depth data were acquired using an Innerspace Model 448 survey grade depth sounder manufactured by Innerspace Technology. Inc. of Waldwick, NJ. Manufacturer's specifications list an instrument resolution of ± 0.1 ft. The system consists of a 208 kHz, 8 degree beam angle sonar transducer, a digital thermal print graphic recorder, and a serial data interface port. The transducer was gunnel-mounted on a vertical pipe on the port side of the survey vessel directly under the GPS antenna.

A bar check, a method of determining sound velocity corrections for depth sounders accepted by the U.S. Army Corps of Engineers, was performed at the start and end of the survey day. This ensured that the sound velocity selected for conversion of sound travel time to depth measurement was accurate. This method consists of lowering a flat metal plate below the depth sounder transducer to a physically measured depth and adjusting the sound velocity so that the depth of the bar reads correctly. Checks were made at 5, 10 and 20 ft. Deeper checks were not practical due to the drift differential between the bar and the survey vessel. Bar check data were recorded on the paper record of the graphic recorder.

The draft or depth of the depth sounder transducer was physically measured down the vertical pipe at a depth of 1.6 ft below the water surface. During the survey the heave, pitch and roll, which affect depth sounder accuracy, were minimal due to quiescent seas.

During the survey the digitized data were spot checked against the graphic recorder data to ensure precise digitization and agreed within 0.1 ft.

2.2.2 Lead Line

Lead line surveys were conducted from the edges of fixed and floating docks in the survey area that were inaccessible by automated survey methods. A lead line measurement consists of using a weighted tape measure to determine a water depth. These data were recorded in a field log book along with time, date, and horizontal position.

The surveys were conducted from fixed or floating docks that could be readily identified from aerial photographs. The state plane coordinate position of a prominent dock feature, such as a corner, could be determined from the aerial photograph. An identified feature was then used as a position origin (i.e. X=0,Y=0) for lead line measurements from the dock.

2.2.3Tag Line

Tag line surveys were conducted in areas that were inaccessible by automated survey methods but accessible by small boat. A Foss skiff was used for the tag line surveys. Tag line measurements were made by running the skiff along a survey trackline from an initial known position at a fixed azimuth. The initial position was determined by aerial photograph as discussed for lead line surveys. The distance from that position was determined by either tape measure or hip chain. The depth was determined using a survey grade depth sounder and graphic recorder with the depth sounder transducer mounted underneath the distance measurement point. The initial position, distance and time of survey were recorded by hand directly on the depth sounder graphic recorder record.

2.2.4Underdock Methods

Under dock surveys were conducted in areas dry at low water by walking under docks and measuring the distance from beams under buildings and docks to the sediment surface. The elevation of individual beams was determined by measuring the distance from the beam to the water surface at high water and calculating its elevation above mean lower low water (MLLW) by subtracting out the tide. These data were entered into a log book along with the time of day.

2.2.5Diver Survey

Enviro-Tech Diving, Inc. of Seattle, WA was contracted to acquire depth data under both the Marine Industries Northwest (MINW) dry dock and the black barge tied to the Foss derelict dock. The position of the diver during the survey was fixed by using a diver-held underwater acoustic location system developed by Desert Star Systems, Inc. of Marina, CA. It consists of 3 underwater acoustic transponders that are placed at non-colinear locations within a survey area and a diver-held underwater navigation computer and depth recorder. The diver swam transects under the dry dock and barge at offsets of 50 ft or less while recording depth data at approximately 5-10 ft intervals. All data were

recorded on the Desert Star System for postprocessing.

2.2.6Tides

A graduated survey staff was erected on a pile at the fixed dock at the Foss facility for use as a tide staff. The tide staff was referenced to a vertical benchmark on the dock. The elevation of the benchmark was surveyed by Sitts and Hill, a land survey company of Tacoma, WA.

Tidal elevations were recorded from the tide staff in a log book from one to four times per hour during the bathymetric surveys.

2.3 Side Scan Sonar

Side scan sonar data was acquired using an EG&G Model 260 Image Correcting side scan sonar system manufactured by EdgeTech of Milford, MA. The system consists of a dual frequency side scan towfish (100/500 kHz), a tow cable, and a topside electronics package and graphic paper recorder . The system produces a slant-range corrected graphic image of the sea bed similar to a plan view photograph. Because the purpose of this survey was to locate large debris that would impede dredging operations the system was operated at the lower resolution 100 kHz frequency.

During the survey the towfish was deployed from the port side of the survey vessel. Because of the shallow water depth (<50 ft, 15 m), the side scan tow cable was set at between 5-10 ft below the water surface directly under the GPS antenna. Thus, no corrections were required during analysis to compensate for towfish layback.

After some initial experimentation the side scan was operated at the 164 ft. (50 m) scale which produced side scan images of a 328 ft. (100 m) survey swath width. Because the waterway is so narrow only a few passes with the side scan were required for complete coverage of the bottom of the waterway.

2.4 Sub-Bottom Profiler

Sub-bottom profiling data was acquired using a Datasonics Model 5000 Sub-Bottom Profiler manufactured by Datasonics of Cataumet, MA. The system consists of a sonar transmitter/receiver data processing unit, a multiple frequency transducer, and an EPC graphic recorder. The transducer was bracket-mounted to the starboard side of the survey vessel beneath the GPS antenna which was switched over to that side for this survey.

The transceiver system was operated at a frequency of 5 kHz. The graphic recorder was set at a 0.025 second full page sweep rate resulting in a full scale data record of about 60 ft. (Maximum water depth along the survey corridor was about 50 ft). The resolution of the data through the sediment was about 1 ft.

2.5 Survey Vessel

The survey vessel used for all the open water surveys was the "R/V Mary H" owned and operated by Sea Lease, Inc. of Bainbridge Island, WA. The "R/V Mary H" is a 26 ft. trailerable shallow draft jet boat.

3.0 ACTIVITIES

A brief summary of field activities is listed in Table 1 followed by a detailed discussion of each activity.

Table 1 Activities Log

June 1997	Field Activity
Wed, 18	Equipment mobilization in Seattle
Thu, 19	Install tide staff; lead line and underdock surveys
Fri, 20	Lead line and underdock surveys
Mon, 23	Equipment mobilization in Seattle
Tue, 24	Mobilize survey vessel for automated bathymetry, side scan and sub-bottom profiling; diver survey
Wed, 25	Diver survey; automated bathymetric survey
Thu, 26	Automated bathymetric survey; side scan sonar and sub-bottom surveys; equipment demobilization
Fri, 27	Tag line surveys; Seattle demobilization

3.1 Bathymetric Surveys

3.1.1 Automated Bathymetric Survey

The survey vessel used for the open water surveys was mobilized on Tuesday, June 24th. The survey vessel was hoisted into the water at Totem Marina on the Thea Foss Waterway and proceeded to the Foss facility on the Middle Waterway. The navigation computer, DGPS equipment, depth sounder and generator were loaded onto the survey vessel, mobilized and tested.

The automated bathymetric survey was run primarily on June 25th

with some additional lines run on the 26th. Because of the high number of mothballed and rafted vessels in the waterway coordination was required with Foss to move most of them out of the waterway during the survey.

Fifty-one cross channel tracklines were run at 50 ft offsets starting near the southern end of the MINW boat shed running towards the mouth of the waterway. Aerial topographic surveys were used to map the waterway from this point to the head of the waterway. Because a long section of log boom was permanently moored at the west side of the mouth of the waterway these cross lines had to be run in multiple sections east and west of the log boom. Also, because the entire survey could not be run at high tide some lines in shallow water had to be completed on the 26th. These included the near shore area on the northeast side of the mouth of the waterway near the pile field, the northwest side of the mouth of the waterway near the abandon marine railway near the Foss facility and several lines south of the MINW boat shed.

In addition eight along channel lines were run as tie lines.

3.1.2Lead Line Survey

Lead line surveys were conducted primarily on Thursday, June 19th and Friday, June 20th. Data were collected along the Foss floating, fixed and condemned docks, and the MINW main dock and finger pier. Also, lead line data was collected on the walkways around the inside of the MINW boat shed. Some lead line data was taken under some of the docks with a small boat that could fit between the piles under the docks.

3.1.3Tag Line Survey

The tag line data was recorded on Friday, June 27th. Surveys were conducted in 4 areas including:

- west of the Foss floating dock - 6 lines
- inside the MINW boat shed - 6 lines
- south of the MINW boat shed - 1 line
- west of the MINW dry dock and finger pier - 10 lines

Distances taped from the initial position were recorded at intervals of 10-25 ft depending on boat speed, length of trackline and site conditions.

3.1.4Underdock Survey

Underdock surveys were conducted on Thursday, June 19th and

Friday, June 20th. Surveys on the 19th included areas under the condemned buildings north of the Foss administrative building, the condemned pier south of the Foss administrative building and under the Foss fixed dock. In addition the elevations of the beams under the condemned buildings north of the Foss administrative building were determined by measuring the distance from the beams to the water's surface at high tide from a small boat.

The underdock surveys on Friday, June 20th focused on the areas under the MINW main dock and in areas under the MINW boat shed. Again, the elevations of the beams from which the top of sediment was measured was determined by measuring the distance from the beam to the water's surface at high tide and subtracting out the tide.

3.1.5Diver Survey

The diver survey was conducted on Tuesday, June 24th and Wednesday, June 25th. The survey under the MINW dry dock was started at high tide in the morning. Three transponders were deployed at locations near the dry dock. The transponder positions were entered into a field log. However, upon entering the water the underwater navigation computer failed to operate properly. It was discovered that one of the underwater connectors failed and caused the system to be inoperative. Because the operator had a replacement part in the Seattle office it was decided that an effort would be made to remobilize at the next high tide that evening.

At 6 PM on the 24th the diver and the system was remobilized to conduct the survey under the dry dock. The survey was completed at about 10 PM. It was decided that it was too late to conduct the survey under the Foss Barge and that work would be continued in the morning.

On the morning of 25th the diver remobilized the acoustic navigation system to piles near the Foss Barge and conducted the underwater survey under the barge.

3.2 Sub-Bottom Profiling Survey

An attempt was made to acquire sub-bottom profiling data to see if the system could define a layer of newly deposited material over native material. It was known that there was a significant amount of biogenic gas in the sediments of the Hylebos Waterway. This is evident at low tide by observing gas bubbling out at the water surface and primarily due to the high degree of organic material in the sediments from waterway logging operations. It was unknown

what the results would be in the Middle Waterway.

Two along-channel tracklines were attempted with mixed results on June 26th. The records show that there were several locations along the trackline where a definitive sediment unit could be discerned. Using an average sound velocity in sediment of 6000 ft/sec this unit appears to range from 2 to 5 ft thick. However, the unit was not clearly defined along the entire route of the trackline. A decision was made in the field to discontinue the survey in favor of finishing the side scan survey that day and demobilizing.

Note that while walking on the mud flats near the MINW boat shed there was evidence of numerous holes in the sediment surface. It is unknown if these were the result of ambient air venting from drained subsurface sediments when flooded by an incoming tide, venting due to biogenic gas or some combination of the two.

No analysis was conducted on the sub-bottom data beyond a cursory field analysis. A copy of the data recorded is on file with HCC.

3.3 Side Scan Sonar Survey

Six side scan sonar survey tracklines lines were run on Thursday, June 26th. Because the waterway was so narrow only a few tracklines were needed to obtain complete coverage. Field observations indicated that there was good overlap and cross-correlation on adjacent tracklines.

4.0 ANALYSIS

4.1 Navigation Data

The positioning data was reviewed for spikes and errors using the HYPACK data correction software. The positioning data was relatively error free and, thus, required very few corrections. The only locations requiring revision, alteration or deletion were those recorded near the MINW dry dock, the MINW boat shed or the Foss condemned building. This is because these features obscured part of the sky reducing the number of GPS satellites available for reception.

4.2 Tidal Elevation Data

A tidal data set compatible with the HYPACK software was constructed from the data recorded from the tide staff. The data were first plotted and compared to NOAA predicted tides to ensure

there were no unusual data spikes or errors. These data were then used to correct all bathymetric data to the MLLW vertical datum.

4.3 Bathymetric Data

4.3.1 Automated Bathymetric Data

Depth sounding data error correction was done concurrently with positioning data review using the same software. Digital data depth profiles were compared with and spot checked against the depth sounder graphic recorder profiles generated during the survey to ensure that the depth data was digitized properly. Typically, digital depth data was in error when the depth sounder transducer passed through the boat's own wake (the sonar signal cannot transmit through the air bubbles of the boat wake) or through a turbidity zone in the upper water column. When an error was found in the digital depth data it was corrected to reflect to the profile found on the graphic recorder output.

4.3.2 Lead Line Data

The lead line data was recorded as depth of sediment from an arbitrary datum on the dock, surface of the water from an arbitrary datum on the dock and time of day. This was done for high docks like the Foss fixed dock, the MINW main dock and the MINW finger pier. Where the depth of water could be clearly observed on the tape measure, such as from the Foss floating dock, only this number and time of day were recorded. The data was entered into a spreadsheet as X, Y, Z , time, and tidal elevation. The raw depth was reduced to MLLW by subtracting the tidal elevation at that time of day.

The position of the depth measurement was fixed by orienting the data relative to a initial known position on the aerial base map.

4.3.3 Tag Line Data

The tag line data was entered into a spreadsheet as X, Y, Z , time, and tidal elevation. Tag line data was reduced by determining depths at fixed distances from the initial tag line transect position and subtracting the tidal elevation to reduce the data to MLLW. The position of the depth measurement was fixed by orienting the data relative to a initial known position on the aerial base map.

4.3.4 Underdock Survey Data

The underdock survey data was analyzed in a similar fashion to the

lead line and tag line data.

4.3.5Diver Survey Data

The diver survey data was analyzed by entering the data in a spreadsheet as X, Y, Z, time and tidal elevation, determining a MLLW depth and plotting the depth data in plan view. The data was then compared with surrounding automated bathymetric, lead line and tag line data to ensure data quality. It appeared as though the data acquired near the baseline of the survey was of questionable quality. Otherwise, the data looked reasonable and, with some editing, was integrated into the comprehensive bathymetric data set.

This underwater diver-held acoustic navigation system used on this project is an emerging technology. Initially, there were some difficulties with implementation of the system. But with a little more planning it appears that the system could provide useful bathymetric data in hard-to-reach areas such as under barges.

4.4 Side Scan Sonar Data

Analysis of the side scan sonar data consisted of observing the records for targets while surveying and reviewing the records during post mission processing. Observed targets were identified and the target positions were extracted from the navigation records. Most of the targets observed on the records were individual logs or piles of logs. These were plotted on a side scan trackline map provided by HCC and returned to HCC for subsequent digitizing and final sea bed hazards map production.