Special Publication SJ2004-SP12

Seawater Demineralization Concentrate Characterization

Technical Memorandum

Technical Memorandum
Seawater Demineralization Concentrate Characterization

by

Reiss Environmental, Inc.

FINAL REPORT

St. Johns River Water Management District
P.O. Box 1429
Highway 100 West
Palatka, Florida

December 2003

CONTENTS

INTRODUCTION 1

PROJECT BACKGROUND 2

SURFACE WATER DISCHARGE CONSIDERATIONS 3

CONCENTRATE WATER QUALITY 5
- Concentrate Sampling MATRIX 6
- Water Quality RESULTS 7

COMPARISON OF CONCENTRATE WATER QUALITY AND SURFACE WATER STANDARDS 12
- Fluoride 14
- Copper 15
- Others 16
- Summary of Water Standards Comparison 16

COMPARISON OF CONCENTRATE WATER QUALITY AND SURFACE WATER BACKGROUND QUALITY 18

CONCLUSIONS 20

REFERENCES 22

APPENDIX A: Water Quality Results

APPENDIX B: Biotoxicity Results

APPENDIX C: Comparison of Concentrate Water Quality with Class II and III Surface Water Standards

INTRODUCTION

The St. Johns River Water Management District (SJRWMD) is implementing programs to reduce the quantity of fresh groundwater withdrawals in order to minimize impacts on environmentally sensitive areas in SJRWMD. As such, SJRWMD is investigating the feasibility of using seawater, brackish ground water and brackish surface water as new alternative water supply sources for drinking water.

Projects implemented by SJRWMD include the *Investigation of Demineralization Concentrate Management* (IDCM), completed by Reiss Environmental, Inc. and the *Seawater Demineralization Feasibility Investigation* (SDFI), which is being completed by R.W. Beck. The IDCM project provided detailed information on demineralization concentrate management regulations and suitable demineralization concentrate management practices. However, this project did not include any direct analysis of concentrate water quality data for comparison with regulations. Similarly, the SDFI project will screen and select five high suitability sites in SJRWMD for a seawater treatment plant but, like the IDCM project, does not involve collection of field data.

SJRWMD implemented this *Seawater Demineralization Concentrate Characterization* (SDCC) project to directly collect water quality data from a seawater demineralization system operating in SJRWMD, for comparison to surface water discharge regulatory requirements. This was considered significant given that surface water discharge is the most common method utilized worldwide for discharge of seawater demineralization concentrate and is a likely alternative for any future seawater demineralization facilities built in SJRWMD. Field data that provide insight into the regulatory considerations associated with this by-product would be of value to municipalities within SJRWMD as they consider future water supply alternatives and directly compliments the two demineralization projects already funded by SJRWMD.

PROJECT BACKGROUND

Preliminary findings of the S*eawater Demineralization Feasibility Investigation* project indicate that the Florida Power & Light (FPL) Cape Canaveral power plant may be a highly suitable site for a future seawater demineralization facility. Independent of the S*eawater Demineralization Feasibility Investigation* project, a pilot study was being conducted by Reiss Environmental at the FPL Cape Canaveral site as part of a federally funded research grant titled *Evaluation of Desalination on Waters under the Influence of Surface Water Runoff for Pretreatment, Water Quality and Pathogen Removal Performance*. The purpose of the pilot study was to evaluate treatment of water withdrawn from the Indian River Lagoon using reverse osmosis as a demineralization technology. The Indian River Lagoon represents a mixed seawater / fresh water body with salinities that can approach full seawater strength during the dry season.

The federally funded project was focused on reverse osmosis fouling rates and was not scoped to address the by-product, concentrate, that is generated in the desalination process. SJRWMD contracted with Reiss Environmental to perform water quality analyses of the concentrate generated during the *Evaluation of Desalination on Waters under the Influence of Surface Water Runoff for Pretreatment, Water Quality and Pathogen Removal Performance* project. These water quality results were then compared to Florida Department of Environmental Protection (FDEP) regulations governing discharge of demineralization concentrate to a surface water body. In particular, the ability to discharge demineralization concentrate back to the Indian River Lagoon was investigated. This report represents the deliverable from that effort.

SURFACE WATER DISCHARGE CONSIDERATIONS

In the event a seawater treatment plant is built on the FPL Cape Canaveral Power Plant site or any other suitable site in SJRWMD, discharge of the concentrate to surface water would have to be permitted through Florida Department of Environmental Protection (FDEP). For the Cape Canaveral Power Plant site, discharge back to the Indian River Lagoon is the most likely consideration. In addition, the existence of a once-through cooling system at the power plant provides approximately 500 MGD of water that could potentially be used for dilution of the demineralization concentrate. While utilization of dilution water is not required by regulation, this technique has been used in the past to minimize the difference in concentrations between the discharge stream and the receiving water body. Conversely, utilization of cooling water discharges for dilution can result in a requirement that the demineralization facility operate only when the power plant cooling water system is operating. Therefore, for the purposes of this assessment, compliance with regulations was assessed with and without dilution.

Discharge of seawater concentrate to a surface water body requires a National Pollutant Discharge Elimination System (NPDES) permit issued from FDEP. As part of the permitting requirements, the classification of the potential surface water has to be identified in order to determine the restrictions associated with discharge into the potential receiving water body. The Indian River Lagoon is classified as a Class II surface water at the Cape Canaveral site. However, given that certain portions of the Indian River Lagoon are Class III waters, both Class II and Class III NPDES requirements are presented in this document. The primary NPDES permitting considerations assessed as part of this project were as follows:

1. FDEP Class II and Class III surface water discharge standards; and
2. FDEP antidegradation policy for receiving waters

Each surface water class, including Class II and III, has a set of surface water standards that must be met at the point of discharge (62-302.500, *F.A.C.*). This includes numerical limits for individual water quality parameters as well as limits on the toxicity of the discharge stream. Dilution of the concentrate can be utilized as long as the dilution occurs prior to the point of discharge into the receiving water body. In

a case where a demineralization concentrate stream does not meet the surface water standards, then a mixing zone must be applied for in order to potentially achieve compliance at the edge of the mixing zone (62-4.244, *F.A.C.*). A mixing zone represents an area within the receiving water body, centered on the point of discharge. Demineralization concentrate from the Cape Canaveral Power Plant pilot study was analyzed for each parameter associated with NPDES permitting requirements.

In addition to requiring compliance with specific water quality standards set for each classification of water body, FDEP's anti-degradation policy requires a public interest test to evaluate the seawater concentrate quality in relation to the background water quality of the receiving water body. As part of the permit evaluation, the demineralization concentrate water quality would be compared to receiving surface water quality. The concentrations of the different concentrate constituents should be less than the ambient concentrations of the receiving water. In the situation where concentrate concentrations are higher than background concentrations, FDEP would determine whether the water quality change would be clearly in the public interest (62-4.242, F.A.C.). In the case where water is withdrawn from the Indian River Lagoon for treatment and the demineralization concentrate is discharged back to the Indian River Lagoon, concentrations of all parameters would be higher than initial values. In this scenario, the anti-degradation policy is of critical importance in assessing the suitability of discharge. However, similar situations have resulted in issuance of an NPDES permit, including the 25 MGD demineralization facility in Tampa, Florida.

In summary, the two key regulatory considerations evaluated for this study were:

- FDEP Class II or Class III surface water discharge standards
- FDEP anti-degradation policy for receiving waters

These two regulatory requirements were evaluated for the concentrate analyzed as part of this project and are presented in the following sections. It should be noted that these two water quality requirements are not inclusive of all requirements associated with FDEP NPDES permit issuance. Additional information on FDEP regulations can be found in the *Applicable Rules and Regulations for Concentrate Management* (Reiss Environmental, 2001).

CONCENTRATE WATER QUALITY

This section of the report presents the concentrate water quality analyzed as part of this project. The pilot plant that generated the concentrate was located at the FPL Cape Canaveral Plant site near Cocoa in Brevard County. The treatment process consisted of pretreating raw water withdrawn from the Indian River Lagoon prior to the seawater reverse osmosis (SWRO) membrane treatment pilot unit (Figure 1). Two pretreatment methods were used: ultrafiltration (UF) unit and multi media filter. Only one chemical, ferric sulfate (coagulant) was added to the raw water stream prior to the pretreatment process. No chemicals were added to the concentrate.

The SWRO system represented a traditional seawater desalination design, utilizing Toray model TM810 seawater elements. The system was operated at 10 gallons per square foot (gfd) flux and 50% recovery. The finished water total dissolved solids (TDS) concentration was less than the secondary standard of 500 mg/L. Based on the 50% recovery, it was expected that the concentration of constituents in the demineralization concentrate stream would be approximately twice that of the feed water.

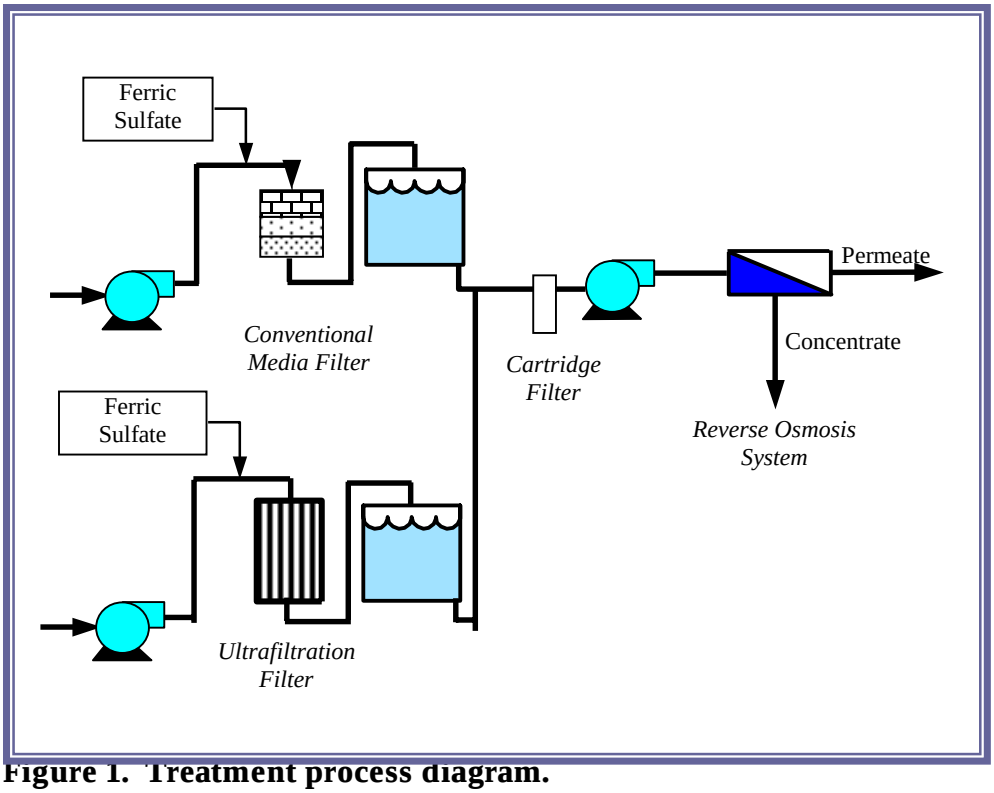


Figure 1. Treatment process diagram.

CONCENTRATE SAMPLING MATRIX

A concentrate sampling matrix was developed based on the requirements of the FDEP permit application for industrial waste water discharge (Form 62-620.910(5)). More specifically the FDEP permit application includes a list of 163 parameters that require analysis. These parameters can be divided into the following categories:

Table VII-A and VII-B parameters: data for these parameters are required for all types of industrial wastewaters (including concentrate streams) discharged into a surface water. This category is composed of parameters in three subcategories: general parameters, radionuclides and metals.

Table VII-C parameters: data for these parameters are required for selected types of industrial wastewaters discharged into a surface water. This category includes volatile organic compounds (VOCs), synthetic organic compounds (SOCs) and dioxins. This category does not typically apply to demineralization water treatment plant (WTP) concentrate. However, FDEP could potentially require an applicant to collect data for these parameters, therefore these analytes were included in this assessment.

In addition to the FDEP permit application requirements, FDEP regulations require evaluation of the whole effluent toxicity of the discharge (62-302.500(1)(a)4, *F.A.C.*). The applicant is to conduct acute toxicity tests using the mysid shrimp, *Mysidopsis bahia*, and the inland silverside minnow, *Menidia beryllina*.

Given the importance of the Table VII-A and VII-B parameters, a total of three samples were collected from the pilot-scale demineralization treatment system at the Cape Canaveral Power Plant. Parameters of less concern (Table VII-C and toxicity) were collected a single time. This sampling matrix, including dates of sample collection, is presented in Table 1. In addition, baseline TDS and chloride data were collected for the raw water, to provide a relative comparison to typical seawater concentrations of approximately 34,000 mg/L and 15,000 mg/L, respectively.

Table 1. Concentrate Sampling Matrix

	Table VII-A	Table VII-B	Table VII-C	Toxicity
Sample 1, June 9, 2003				
Sample 2, July 14, 2003				
Sample 3, July 28, 2003				

WATER QUALITY RESULTS

This section of the report presents the water quality results from the three raw and concentrate samples taken in support of this project. Raw water TDS and chloride levels are presented in Table 2. As shown, TDS was approximately 21,100-24,300 mg/L, which is 28-38% less than typical Atlantic Ocean TDS level of 34,000 mg/L. This is indicative of the influence of fresh water runoff in the Indian River Lagoon during the rainy summer season. Chloride levels were 13-27% less than the typical 15,000 mg/L concentration in the Atlantic Ocean. Nevertheless, use of this water supply would require a conventional demineralization treatment facility consistent with typical seawater systems.

Table 2. Raw Water Quality Results

Sample	Conductance (umho/cm)	TDS * (mg/L)	Chloride (mg/L)
Sample 1, June 9, 2003	38,000	24,300	13,000
Sample 2, July 14, 2003	35,000	22,400	12,000
Sample 3, July 28, 2003	33,000	21,100	11,000

* Estimated based on conductance results

Demineralization concentrate water quality results are presented in Table 3. The data for Table VII-A and B parameters (general, radionuclides and metals) represent an average of the three samples taken. Data for Table VII-C parameters (VOCs, SOCs and dioxin) and toxicity represent the results for the single sample obtained. Complete results for all sampling events are presented in Appendices A and B.

Table 3. Concentrate Water Quality

Parameters	Units	Concentration[(a)]	Maximum
General (22)			
Carboneous Biochemical Oxygen Demand (CBOD)	mg/L	< 2	< 2
Chemical Oxygen Demand (COD)	mg/L	320	360
Total Organic Carbon (TOC)	mg/L	19	20
Total Suspended Solids (TSS)	mg/L	26	58
Total Nitrogen (as N)	mg/L N	1.2	1.3
Total Phosphorus (as P)	mg/L P	0.08	0.19
Specific Conductivity	µmohs/cm	66,000	69,000
pH	SU	8	8.2
Bromide	mg/L	85	94
Color	PCU	17	20
Fecal Coliform	Ct/100 mL	< 1	< 1
Fluoride	mg/l	1.6	1.8
Chloride	mg/L	25,500	28,000
Nitrate-Nitrite	mg/L N	< 0.01	< 0.01
Nitrogen, total organic (as N)	mg/L N	1.17	1.2
Oil and Grease	mg/L	< 5	< 5
Phosphorus, orthophosphate	mg/L P	< 0.01	< 0.01
Sulfate as SO4	mg/L	3,700	3,900
Sulfide as S	mg/L	0.1	0.1
Sulfite as SO3	mg/L	< 2	< 2
Surfactants	mg/L	0.08	0.11
Total phenolic compounds	mg/L	< 0.05	< 0.05
Radionuclides (4)			
Alpha, gross	pCi/L	3.4	4.7
Radium, total	pCi/L	1.9	2.8
Radium 226	pCi/L	1.6	2.1
Radium 228	pCi/L	1.1	1.8

Table 3 (Continued)

Parameters	Units	Concentration	Maximum
Metals (24)			
Aluminum, total	mg/L	< 0.10	< 0.10
Antimony	mg/L	< 0.005	< 0.005
Arsenic	mg/L	< 0.005	< 0.005
Barium, total	mg/L	0.04	0.04
Beryllium	mg/L	0.00006	0.00011
Boron, total	mg/L	3.3	3.6
Cadmium	mg/L	< 0.002	< 0.002
Chromium	µg/L	< 0.01	< 0.01
Cobalt, total	mg/L	< 0.01	< 0.01
Copper	µg/L	8.0	11.0
Cyanide	mg/L	< 0.005	< 0.005
Iron, total	mg/L	< 0.02	< 0.02
Lead	mg/L	< 0.002	< 0.002
Magnesium, total	mg/L	1,667	1,800
Manganese, total	mg/L	< 0.01	< 0.01
Mercury	µg/L	< 0.0002	< 0.0002
Molybdenum, total	mg/L	< 0.01	< 0.01
Nickel	µg/L	4.1	6.0
Selenium	mg/L	< 0.01	< 0.01
Silver	mg/L	< 0.00025	< 0.00025
Thallium	mg/L	< 0.005	< 0.005
Tin, total	mg/L	< 0.10	< 0.10
Titanium, total	mg/L	< 0.01	< 0.01
Zinc	mg/L	< 0.01	< 0.01
2,3,7,8-Tetra-chlorodibenzo-P-Dioxin (1)	pg/L	< 1.00	--
Volatile organic compounds (28)	µg/L	< DL	--
Synthetic organic compounds (83)	µg/L	< DL	--
Toxicity (1)[(b)]			
Acute Toxicity on Myrid Shrimp	% for 96 hr LC50[(1)]	> 100	--
Acute Toxicity on Silverside Minnow	% for 96 hr LC50[(1)]	> 100	--

(a) represents average of three samples for general, radionuclides, and metals
(b) if LC50 > 100%, sample is not toxic
DL: Detection Limit

It should be noted that the concentrations of most of the inorganic and organic compounds are expected to be twice as high as the concentrations in the raw water. This is due to the fact that the recovery of the system was 50%, therefore, constituents were generally concentrated by a factor of 2, since there is the same mass in half the volume of water. It is important to note that the data obtained for this study is specifically raw water from the Indian River Lagoon. This water is referred to as seawater under the influence of fresh water runoff.

General

The average demineralization concentrate conductance was 69,000 µS/cm, which represents a TDS of approximately 44,000 mg/L. This is twice that of the feed water, as was expected. The average chloride concentration was approximately 25,500 mg/L. This is twice as high as the feed water. In contrast, the TDS of the Atlantic Ocean is approximately 34,000 mg/L and the chloride is approximately 15,000 mg/L.

Also, the nutrient levels were very low as expected. Total nitrogen and total phosphorus were found to be 1.2 and 0.08 mg/L, respectively. Nitrate-Nitrite, orthophosphate as phophorous were all below detection limits.

Radionuclides

It was noted that Radium 226, Radium 228 and Gross Alpha were all detected at low levels in the concentrate stream. Due to erosion of natural deposits, radionuclides can be detected at low levels in raw source waters and at higher levels in the concentrate stream proportional to the system recovery rate.

Metals

Out of the twenty-four metals tested only six were detected: barium, beryllium, boron, copper, magnesium and nickel. Barium and beryllium were detected at concentrations just above the detection limits.

Dioxin, VOCs and SOCs

Neither volatile organic compounds (VOCs) nor synthetic organic compounds (SOCs) were detected in the concentrate. All VOCs and SOCs were below the detection limits (See Appendix A). Dioxin was also not detected.

Toxicity

Acute toxicity tests using mysid shrimp and silverside minnow showed no mortality and the calculated 96hr LC50 is > 100%, which means that the concentrate is not toxic. The toxicity tests results are presented in Appendix B.

COMPARISON OF CONCENTRATE WATER QUALITY AND SURFACE WATER STANDARDS

Since the Indian River at this location is classified as a Class II surface water, discharge of concentrate from any future proposed seawater treatment plant at the Cape Canaveral Plant site would be required to comply with FDEP regulations for Class II surface waters. For the purposes of this study, the concentrate water quality obtained during the pilot study was compared to both the Class II and Class III surface water standards in order to assess the feasibility of discharging concentrate from a seawater treatment plant at other locations district-wide. The Class II and Class III standards are the same for each parameter listed in the FDEP industrial waste discharge form, except for fluoride. The surface water standards are presented in Appendix C. These standards have to be met in order to discharge concentrate to surface water. If surface water standards are not met at the point of discharge, then the FDEP may consider approval of a mixing zone to dilute the concentrate to a degree to meet surface water standards at the edge of the mixing zone. Grant of a mixing zone would depend on the parameter in excess of the standard. For example, it is unlikely that a mixing zone would be granted for a parameter to be known carcinogenic.

The analytical results of the 163 parameters sampled from the concentrate stream were compared to Class II and Class III surface water standards (Appendix C). It is important to note that out of the 163 parameters, only 53 have a Class II and Class III surface water standard. Therefore, only the results of these 53 parameters were compared to their respective standards. The other 110 parameters do not have listed standards and, as such, no comparisons were made for this study. It is also important to note that FDEP will evaluate the results of these 110 parameters based on the results of the toxicity testing.

If the toxicity tests show that the concentrate is not toxic and that all parameters that are known to be carcinogenic, mutagenic, or teratogenic are below detection limit, no further testing would typically be required (FDEP, 2003). However, if the toxicity tests show that the concentrate is not toxic but one or several parameters known to be carcinogenic, mutagenic, or teratogenic are detected in the concentrate, further specific toxicity tests would be required by FDEP.

Among these 110 parameters without listed standards, some are known to be "carcinogenic, mutagenic, or teratogenic to human beings or to significant, locally occurring, wildlife or aquatic species" (Eighty metals, SOCs and VOCs). If any of these are present in the concentrate stream, further evaluation may be required by FDEP while the other 30 parameters are not typically of concern (FDEP, 2003).

During the pilot study at the Cape Canaveral, the 80 parameters of the 110 parameters without surface water standard that are known to be carcinogenic, mutagenic, or teratogenic had analytical results below the detection limit. In addition the concentrate was found to be non toxic. Therefore, no further tests would be required.

Comparison of the concentrate water quality to Class II standards showed that out of the 53 parameters having a Class II standard, 40 complied with Class II surface water standards, 2 did not meet the standards and 11 had detection limits above the standard, therefore no conclusion could be drawn. Table 4 summarizes this assessment. While the Class II fluoride standard was not met, the Class III fluoride standard was met. This is the sole difference between the assessment of Class II and Class III standards compliance.

Table 4. Comparison of Concentrate Water Quality and Class II, III Standards

Parameters that	Class II	Class III
Do not have standards	110	110
Meet standards	40	41
Do not meet standards	2	1
Do not meet standards, but standard lower than detection limit	11 BDL	11 BDL
TOTAL	53	53

BDL: below detection limit

Table 5 shows which parameters do no meet Class II and Class III surface water standards. All the others are presented in Appendix C.

Table 5. Comparison of Concentrations to Surface Water Standards

Parameter	Concentrate	Surface Water Standards	
		Class II	Class III (marine)
Fluoride (mg/L)	1.6 (Max = 1.8)	1.5	5
Copper (µg/L)	8.0 (Max = 11.0)	3.7	3.7

As a case study, the concentrate quality from the seawater pilot plant performed at FPL's Cape Canaveral site does not meet the surface water standards for Class II fluoride standard (Table 5). In addition, the concentrate quality does not meet the Class II or Class III copper standards, as shown in Table 5. At the discretion of the FDEP, this is a scenario where both fluoride and copper levels may be addressed through the implementation of a mixing zone.

Details of the comparison of the concentrate water quality with Class II and Class III surface water standards are presented in the following subsections.

FLUORIDE

As mentioned previously, the fluoride concentration in the concentrate stream did not meet Class II surface water standard, however, it met the Class III surface water standard (see Table 5 above). In order to comply with the Class II standard, a mixing zone would be required. The sizing of a mixing zone is based on the degree to which the concentration of the specific parameter in question needs to be diluted. In the case of fluoride, the dilution factor would need to be at least 1.1 in order to meet the Class II fluoride standard. This is based on utilization of water from the Indian River Lagoon with a background concentrate of fluoride of 0.9 mg/L. This dilution ratio would require 0.2 MGD of dilution water for every 1.0 MGD of concentrate. Per FDEP regulations, mixing zones shall not include a nursery area of indigenous aquatic life or any area approved by the FDEP for shellfish harvesting. It is the responsibility of the applicant to communicate and formally request a determination from FDEP whether the proposed location for discharge is designated as an official shellfish harvesting area or not (FDEP, 2003).

Since the Indian River Lagoon in the vicinity of the FPL Cape Canaveral Plant is designated as a shellfish harvesting or propagation water, fluoride is a potential concern at this location. Mixing zones are not approved for areas classified as shellfish harvesting or propagation waters. In order to discharge concentrate at the Power Plant site, the discharge line should be extended to either a Class III surface water or to a Class II surface water not designated as shellfish harvesting water. An additional and more likely option is utilization of the 500 MGD of cooling water discharge from the power plant for dilution.

COPPER

The copper levels do not meet either the Class II or the Class III surface water standards. In order to comply with Class II and III standard, a mixing zone would be required in both cases. In the case of copper, a dilution factor of at least 3.5 (1 MGD of concentrate with 2.5 MGD of receiving water) would be required in order to meet either the Class II or Class III copper standard. This is based on using the Indian River Lagoon, with a background copper concentration of 2 µg/L, as the dilution water. Note that additional data collected over a full season may reveal more extensive dilution needs since this data was for a specific point in time during the summer of 2003.

It should be noted that only one raw water sample was collected for the copper analyses whereas three concentrate samples were collected for analyses. The copper concentrations are presented in Table 6. The copper concentration in the raw water was found to be 2.0 µg/L. During the *Evaluation of Desalination on Waters under the Influence of Surface Water Runoff for Pretreatment, Water Quality and Pathogen Removal Performance* Project, two other raw water samples were collected and copper concentrations were 2.3 µg/L (June 30, 2003) and 1.4 µg/L (July 22, 2003). Therefore, the copper concentration in the Lagoon River was approximately 2.0 µg/L in average. The concentrate to raw water ratio for sample No. 2 copper levels was approximately 2.8 when a ratio of 2 is expected. This slight difference could be explained by a number of factors including analytical accuracy limitations at low concentrations and corrosion of alloy parts of the seawater pilot.

Table 6. Copper Concentrations

Sample #	Raw water Copper	Concentrate Copper
	µg/L	µg/L
1	NS	7.3
2	2.0	5.7
3	NS	11.0

NS: not sampled

Due to the shellfish harvesting water restrictions on mixing zones, the copper levels detected in the concentrate would be a concern (see Fluoride discussion above).

OTHERS

Table 7 summarizes the 11 parameters that have analytical detection limits higher than the listed Class II and Class III water quality standard. For these parameters the concentration was below the detection limit; however, no definite conclusions can be made on whether surface water standards would be met or not. These parameters were analyzed using EPA methods (Table 7) which are approved under the Federal NPDES program (Title 40 of CFR, part 136). If these contaminants are present in the concentrate, the contaminants were most likely present in the raw water, since the SWRO process will not produce these contaminants. These contaminants are not naturally occurring in seawater.

As shown, demineralization concentrate monitoring and compliance parameters are not always consistent with analytical techniques employed by commercial laboratories. In addition, the regulatory limits for parameters are not always consistent with analytical quantification levels, especially for saline samples. In order to ensure compliance with FDEP standards, a review of these disparities between detection limits and standards is recommended.

Table 7. Parameters for which detection limit is higher than surface water standard

Parameter	Units	Detection limit	EPA Method	Class II and III Standard	Concentration
Mercury	µg/L	0.200	245.1	0.025	< 0.2
Cyanide	µg/L	5.0	335.2	1.0	< 5.0
Pentachlorophenol	µg/L	10	625	7.9	< 10
2,4,6-trichlorophenol	µg/L	10	625	6.5	< 10
2,4-dinitrotoluene	µg/L	10	608	9.1	< 10
Chlordane	µg/L	0.05	608	0.0040	< 0.05
4,4[prime]-DDT	µg/L	0.01	608	0.0010	< 0.01
Dieldrin	µg/L	0.01	608	0.0019	< 0.01
Endrin	µg/L	0.01	608	0.0023	< 0.01
Heptachlor	µg/L	0.01	608	0.0036	< 0.01
Toxaphene	µg/L	0.5	608	0.0002	< 0.5

SUMMARY OF WATER STANDARDS COMPARISON

Analytical results of SWRO concentrate from the pilot study at the FPL Cape Canaveral plant were compared with FDEP water quality

standards for wastewater discharge to receiving water bodies. Of the 163 parameters from the FDEP list, 131 parameters were not detected in the concentrate. However, the detection limits of eleven of these parameters are higher than the surface water standards, and, as such, no conclusions can be made relative to regulatory compliance. It is likely that these parameters will not be found in the concentrate since the operation of the SWRO technology will not produce these contaminants. In instances where these chemicals are present in the concentrate, they would be also present in the seawater.

Of the 32 parameters detected in the concentrate samples, only fluoride and copper were detected above a Class II or Class III water quality standard. In order to discharge the concentrate into a Class II surface water, a mixing zone would be required for both fluoride and copper. The mixing zone would provide the dilution capacity to potentially allow meeting the Class II surface water standard as long as the discharge occurs in a Class II surface water not designated as shellfish harvesting water. If a Class III surface water is used as receiving water for concentrate from a seawater demineralization WTP, then a mixing zone would only be required for copper.

COMPARISON OF CONCENTRATE WATER QUALITY AND SURFACE WATER BACKGROUND QUALITY

In addition to compliance with water quality standards discussed previously, the concentrate water quality also cannot be a detriment to current surface water quality in the receiving surface water. To determine the potential impact of concentrate discharge to the current water quality of the Indian River, a comparison of the analytical results for the raw source water and the SWRO concentrate stream is discussed below.

In addition to the copper and fluoride concentration levels in the concentrate stream exceeding the surface water standards (see previous section), the total dissolved solids (TDS) concentration of the concentrate stream is also a concern. As expected the concentrate TDS level is approximately twice the source water TDS due to the 50% recovery of the SWRO process, as shown earlier. Therefore, direct discharge of the concentrate into the Indian River Lagoon would have to be weighed against the public interest according to the anti-degradation policy. This policy states that the water quality of the discharge shall not result in deterioration of the background water quality of the receiving water. However, if the discharge is in the interest of the public, FDEP may consider an increase in TDS of the receiving water. For this reason, blending concentrate with power plant cooling water was evaluated in this study.

Blending seawater concentrate with single pass power plant cooling water provides the potential to substantially reduce the impact of high TDS concentrations in a concentrate discharge stream. To determine the capability of the Cape Canaveral Plant cooling water system to dilute the high TDS, fluoride, and copper concentrations resulting from demineralization WTPs of sizes from 2 to 25 MGD, an analysis was conducted to determine the ability for this power plant facility to dilute an estimated 44,000 mg/L TDS demineralization concentrate for different flows of concentrate. The estimate is based on water quality of the concentrate obtained during the pilot testing operations. The results of the analysis are presented in Table 8 below. As shown, a net increase in the TDS of a blended water stream would occur and would range from 0.3 to 4.8 percent.

Table 8. Water Quality of Blended Concentrate with Cooling Water

Concentrate Flow	MGD	2	5	10	25
Cooling Water Flow	MGD	500	500	500	500
Concentrate TDS	mg/L	44,000	44,000	44,000	44,000
Cooling Water TDS	MGD	22,000	22,000	22,000	22,000
Blend TDS	mg/L	22,087	22,217	22,431	23,047
TDS increase	%	0.4	1.0	2.0	4.8
Max. Concentrate Fluoride	mg/L	1.8	1.8	1.8	1.8
Cooling Water Fluoride	mg/L	0.95	0.95	0.95	0.95
Blend Fluoride	mg/L	0.95	0.96	0.97	0.99
Class II SW F Standard	mg/L	1.5	1.5	1.5	1.5
Max. Concentrate Copper	mg/L	11	11	11	11
Cooling Water Copper	mg/L	2	2	2	2
Blend Copper	mg/L	2.04	2.09	2.18	2.43
Class II, III SW Cu Standard	mg/L	3.7	3.7	3.7	3.7

A TDS increase of only 0.3 percent in the receiving water due to blending with high TDS content concentrate is low, however, the demineralization concentrate permitting history associated with the 25-MGD Tampa Bay Water demineralization facility clearly shows that obtaining approval for any increase in TDS concentration can be very time consuming, and costly and may not be assured.

Blending seawater concentrate with power plant cooling water could also minimize the impact of fluoride concentrations. As shown in Table 8, the fluoride concentration in the blended stream would be less than the Class II surface water standard and therefore no mixing zone would be required for fluoride. In addition, blending would also reduce the impact of copper concentrations and the blended stream would also meet the Class II and III copper surface water standards. In order to eliminate any concerns with raw water copper contamination and therefore minimize copper concentration in the concentrate, copper could be removed from the source water before demineralization treatment. Coagulation / filtration is one of the pretreatments prior to seawater demineralization that would remove copper. Coagulant dose and coagulation pH would have to be determined in order to optimize copper removal.

CONCLUSIONS

As shown in the pilot study analytical results, the concentration level of most constituents in the concentrate from our seawater RO process were approximately twice the value of the concentration of the raw water values from the source water since the recovery for this seawater system was approximately 50 percent.

Based on the analytical results of the demineralization concentrate generated from the FPL Cape Canaveral Plant pilot study, the concentrate water quality from this SWRO process meets the surface water standards of Class II and III surface waters, except for fluoride in excess of Class II surface water standard and copper in excess of both the Class II and III surface water standards. Therefore, a mixing zone would be required to meet the fluoride and copper surface water standards. The concentrate from this pilot plant was determined to be non-toxic to Mysid Shrimp and Silverside minnow.

It was found that the detection limits of eleven parameters are higher than the surface water standards, and, as such, no conclusions can be made relative to regulatory compliance. It is likely that these parameters will not be found in the concentrate since the operation of the SWRO technology will not produce these contaminants.

In order to permit a direct discharge of the concentrate into the Indian River Lagoon, the TDS increase (TDS of the concentrate is twice as high as the TDS of the receiving water) would have to be weighed against benefits for the public interest according to the anti-degradation policy. This would typically be the case for all scenarios in which the source water supply is also the receiving surface water considered for the concentrate discharge. An increase in TDS would not necessarily result in degradation of the water quality of the receiving water. Some estuarine and lagoonal waters along the Florida coast have exhibited decreases in salinity compared to predevelopment conditions due to increased stormwater runoff and discharges of reclaimed water. Such decreases in salinity have often been associated with adverse environmental impacts. Therefore, the increased salinity associated with a discharge of demineralization concentrate into such waters might be weighed favorably under some circumstances.

One of the benefits of blending seawater concentrate with power plant cooling water is that the increase of TDS concentration is greatly minimized. The increase in TDS would be less than 2.0% for a seawater plant with a capacity of less than 10 MGD, when using the

500 MGD of cooling water available at the Cape Canaveral Power Plant.

Discharge in Class II or Class III surface water would be considered by FDEP if:

- the increase in TDS is in the public interest, and
- a mixing zone (outside shellfish harvesting area) is granted by FDEP for parameters in excess of Class II or III surface water standards.

Or,

- the concentrate is blended with cooling water or other sources to minimize increases in concentrations in the receiving water

REFERENCES

[FDEP] Florida Department of Environmental Protection. Various Dates. *Florida Administrative Code.* Title 62. Tallahassee, Fla.

_____. 2003. [FDEP] Florida Department of Environmental. Personal Communication

Reiss Environmental (2003). Demineralization Concentrate Management Plan, St. Johns River Water Management District, Palatka, FL.

Reiss Environmental (2001). Applicable Rules and Regulations for Concentrate Management, St. Johns River Water Management District, Palatka, FL.

APPENDIX A

Water Quality Results

Parameters	Units	Average Concentrations		
		Raw	Permeate	Concentrate
1. General				
Carboneous Biochemical Oxygen Demand (CBOD)	mg/L	2.93	< 2	< 2
Chemical Oxygen Demand (COD)	mg/L	183	< 10	320
Total Organic Carbon (TOC)	mg/L	9.93	< 1	19.33
Total Suspended Solids (TSS)	mg/L	18.33	2.67	26.33
Total Nitrogen (as N)	mg/L N	0.75	< 0.05	1.20
Total Phosphorus (as P)	mg/L P	0.05	< 0.03	0.08
Specific Conductivity	umohs/cm	35333	486.67	65000
pH	SU	8.47	7.70	7.97
Bromide	mg/L	42.00	0.62	85.00
Color	PCU	10.00	< 5	16.67
Fecal Coliform	Ct/100 mL	5.67	< 1	< 1
Fluoride	mg/l	0.96	< 0.003	1.57
Chloride	mg/L	12000	146.67	25333
Nitrate-Nitrite	mg/L N	0.01	0.03	0.01
Nitrogen, total organic (as N)	mg/L N	0.72	0.05	1.17
Oil and Grease (hexane extractable material)	mg/L	< 5.00	< 5.00	< 5.00
Phosphorus, orthophosphate	mg/L P	0.01	0.02	0.01
Alpha, gross	pCi/L	2.27	0.60	3.40
Beta, gross	pCi/L	NA	1.50	NA
Radium, total	pCi/L	1.60	0.40	1.93
Radium 226	pCi/L	0.97	0.20	1.60
Radium 228	pCi/L	1.10	0.65	1.13
Sulfate as SO4	mg/L	1633	3.43	3700
Sulfide as S	mg/L	0.10	0.20	0.13
Sulfite as SO3	mg/L	< 2.00	< 2.00	< 2.00
Surfactants	mg/L	0.20	0.05	0.09
Aluminum, total	mg/L	0.18	0.10	0.10
Barium, total	mg/L	0.02	0.04	0.04
Boron, total	mg/L	2.30	1.08	3.27
Cobalt, total	mg/L	< 0.01	< 0.01	< 0.01
Iron, total	mg/L	0.14	0.02	0.02
Magnesium, total	mg/L	823	1.33	1667
Molybdenum, total	mg/L	< 0.01	< 0.01	< 0.01
Manganese, total	mg/L	< 0.01	< 0.01	< 0.01
Tin, total	mg/L	< 0.10	< 0.10	< 0.10
Titanium, total	mg/L	< 0.01	< 0.01	< 0.01

2. Metals (total recoverable), cyanide and total phenols				
Antimony	mg/L	< 0.01	< 0.001	< 0.01
Arsenic	mg/L	< 0.01	< 0.001	< 0.01
Beryllium	mg/L	0.00006	< 0.0001	0.00006
Cadmium	mg/L	< 0.002	< 0.002	< 0.002
Chromium	mg/L	< 0.01	< 0.01	< 0.01
Copper (chelation extraction)	ug/L	2.0	< 1.0	8.0
Lead	mg/L	< 0.002	< 0.001	< 0.002
Mercury	mg/L	< 0.0002	< 0.0002	< 0.0002
Nickel (chelation extraction)	ug/L	< 0.001	< 0.001	4.1
Selenium	mg/L	< 0.01	< 0.002	< 0.01
Silver	mg/L	< 0.00025	< 0.001	< 0.00025
Thallium	mg/L	< 0.01	< 0.01	< 0.01
Zinc	mg/L	< 0.01	< 0.01	< 0.01
Cyanide	mg/L	< 0.01	< 0.01	< 0.01
Total phenolic compounds	mg/L	< 0.05	< 0.05	< 0.05
3. Dioxin				
2,3,7,8-Tetra-chlorodibenzo-P-Dioxin (subcontract)	pg/L	< 1.00	NA	< 1.00
4. GC Fraction - Volatile organic compounds				
Acrolein	ug/L	< 5.00	NA	< 5.00
Acrylonitrile	ug/L	< 5.00	NA	< 5.00
Benzene	ug/L	< 0.50	NA	< 0.50
Bromoform	ug/L	< 0.50	NA	< 0.50
Carbon tetrachloride	ug/L	< 0.30	NA	< 0.30
Chlorobenzene	ug/L	< 0.30	NA	< 0.30
Chlorodibromomethane	ug/L	< 0.50	NA	< 0.50
Chloroethane	ug/L	< 0.50	NA	< 0.50
2-chloroethylvinyl ether	ug/L	< 0.50	NA	< 0.50
Chloroform	ug/L	< 0.20	NA	< 0.20
Dichlorobromomethane	ug/L	< 0.30	NA	< 0.30
Dichloro-difluromethane	ug/L	< 0.50	NA	< 0.50
1,1-dichloroethane	ug/L	< 0.30	NA	< 0.30
1,2-dichloroethane	ug/L	< 0.20	NA	< 0.20
Trans-1,2-dichloroethylene	ug/L	< 0.50	NA	< 0.50
1,1-dichloroethylene	ug/L	< 0.50	NA	< 0.50
1,2-dichloropropane	ug/L	< 0.30	NA	< 0.30
1,3-dichloropropylene	ug/L	< 0.30	NA	< 0.30
Ethylbenzene	ug/L	< 0.50	NA	< 0.50
Methylene chloride	ug/L	< 0.50	NA	< 0.50
1,1,2,2-tetrachloroethane	ug/L	< 0.30	NA	< 0.30
Tetrachloroethylene	ug/L	< 0.20	NA	< 0.20
Toluene	ug/L	< 0.50	NA	< 0.50
1,1,1-trichloroethane	ug/L	< 0.30	NA	< 0.30
1,1,2-trichloroethane	ug/L	< 0.30	NA	< 0.30

Trichloroethylene	ug/L	< 0.20	NA	< 0.20
Trichloro-fluromethane	ug/L	< 0.50	NA	< 0.50
Vinyl chloride	ug/L	< 0.50	NA	< 0.50
5. GC/MS Fraction Acid-extractable compounds				
6. GC/MS Fraction Base-neutral compounds				
2-chlorophenol	ug/L	< 10.00	NA	< 10.00
2,4-dichlorophenol	ug/L	< 10.00	NA	< 10.00
2,4-dimethylphenol	ug/L	< 10.00	NA	< 10.00
4,6-dinitro-o-cresol	ug/L	< 50.00	NA	< 50.00
2,4-dinitrophenol	ug/L	< 50.00	NA	< 50.00
2-nitrophenol	ug/L	< 10.00	NA	< 10.00
4-nitrophenol	ug/L	< 50.00	NA	< 50.00
Pentachlorophenol	ug/L	< 10.00	NA	< 10.00
Phenol	ug/L	< 10.00	NA	< 10.00
2,4,6-trichlorophenol	ug/L	< 10.00	NA	< 10.00
Acenaphthene	ug/L	< 10.00	NA	< 10.00
Acenaphthylene	ug/L	< 10.00	NA	< 10.00
Anthracene	ug/L	< 10.00	NA	< 10.00
Benzidine	ug/L	< 30.00	NA	< 30.00
Benzo(a)anthracene	ug/L	< 10.00	NA	< 10.00
Benzo(a)pyrene	ug/L	< 10.00	NA	< 10.00
3,4 benzofluoranthene	ug/L	< 10.00	NA	< 10.00
Benzo(ghi)perylene	ug/L	< 10.00	NA	< 10.00
Benzo(k)fluoranthene	ug/L	< 10.00	NA	< 10.00
Bis (2-chloroethoxy) methane	ug/L	< 10.00	NA	< 10.00
Bis (2-chloroethyl) ether	ug/L	< 10.00	NA	< 10.00
Bis (2-chloroisopropyl) ether	ug/L	< 10.00	NA	< 10.00
Bis (2-ethylhexyl) phthalate	ug/L	< 10.00	NA	< 10.00
4-bromophenyl phenyl ether	ug/L	< 10.00	NA	< 10.00
Butyl benzyl phthalate	ug/L	< 10.00	NA	< 10.00
2-chloronaphthalene	ug/L	< 10.00	NA	< 10.00
4-chlorophenyl phenyl ether	ug/L	< 10.00	NA	< 10.00
Chrysene	ug/L	< 10.00	NA	< 10.00
Di-n-butyl phthalate	ug/L	< 10.00	NA	< 10.00
Di-n-octyl phthalate	ug/L	< 10.00	NA	< 10.00
Dibenzo(a,h)anthracene	ug/L	< 10.00	NA	< 10.00
1,2-dichlorobenzene	ug/L	< 10.00	NA	< 10.00
1,3-dichlorobenzene	ug/L	< 10.00	NA	< 10.00
1,4-dichlorobenzene	ug/L	< 10.00	NA	< 10.00
3,3-dichlorobenzidine	ug/L	< 10.00	NA	< 10.00
Diethyl phthalate	ug/L	< 10.00	NA	< 10.00
Dimethyl phthalate	ug/L	< 10.00	NA	< 10.00
2,4-dinitrotoluene	ug/L	< 10.00	NA	< 10.00
2,6-dinitrotoluene	ug/L	< 10.00	NA	< 10.00
1,2-diphenylhydrazine	ug/L	< 10.00	NA	< 10.00
Fluoranthene	ug/L	< 10.00	NA	< 10.00

Fluorene	ug/L	< 10.00	NA	< 10.00
Hexachlorobenzene	ug/L	< 10.00	NA	< 10.00
Hexachlorobutadiene	ug/L	< 10.00	NA	< 10.00
Hexachlorocyclo-pentadiene	ug/L	< 10.00	NA	< 10.00
Hexachloroethane	ug/L	< 10.00	NA	< 10.00
Indeno(1,2,3-cd)pyrene	ug/L	< 10.00	NA	< 10.00
Isophorone	ug/L	< 10.00	NA	< 10.00
Naphthalene	ug/L	< 10.00	NA	< 10.00
Nitrobenzene	ug/L	< 10.00	NA	< 10.00
N-nitrosodi-n-propylamine	ug/L	< 10.00	NA	< 10.00
N-nitrosodimethylamine	ug/L	< 10.00	NA	< 10.00
N-nitrosodiphenylamine	ug/L	< 10.00	NA	< 10.00
Phenanthrene	ug/L	< 10.00	NA	< 10.00
Pyrene	ug/L	< 10.00	NA	< 10.00
1,2,4,-trichlorobenzene	ug/L	< 10.00	NA	< 10.00
7. GC/ECD Fraction - Pesticides				
Aldrin	ug/L	< 0.01	NA	< 0.01
alpha-BHC	ug/L	< 0.01	NA	< 0.01
beta-BHC	ug/L	< 0.02	NA	< 0.02
gamma-BHC	ug/L	< 0.00	NA	< 0.00
delta-BHC	ug/L	< 0.01	NA	< 0.01
Chlordane	ug/L	< 0.05	NA	< 0.05
4,4[prime]-DDT	ug/L	< 0.01	NA	< 0.01
4,4[prime]-DDE	ug/L	< 0.01	NA	< 0.01
4,4[prime]-DDD	ug/L	< 0.01	NA	< 0.01
Dieldrin	ug/L	< 0.01	NA	< 0.01
alpha-Endosulfan	ug/L	< 0.01	NA	< 0.01
beta-Endosulfan	ug/L	< 0.01	NA	< 0.01
Endosulfan Sulfate	ug/L	< 0.01	NA	< 0.01
Endrin	ug/L	< 0.01	NA	< 0.01
Endrin Aldehyde	ug/L	< 0.01	NA	< 0.01
Heptachlor	ug/L	< 0.01	NA	< 0.01
Heptachlor Epoxide	ug/L	< 0.01	NA	< 0.01
PCB-1242	ug/L	< 0.20	NA	< 0.20
PCB-1254	ug/L	< 0.20	NA	< 0.20
PCB-1221	ug/L	< 0.20	NA	< 0.20
PCB-1232	ug/L	< 0.20	NA	< 0.20
PCB-1248	ug/L	< 0.20	NA	< 0.20
PCB-1260	ug/L	< 0.20	NA	< 0.20
PCB-1016	ug/L	< 0.20	NA	< 0.20
Toxaphene	ug/L	< 0.50	NA	< 0.50

NA: not analyzed

APPENDIX B

Biotoxicity Results

Page 1 of 12.

State of Florida Wastewater Whole Effluent Toxicity Testing Report Form

All blanks on this form are to be filled in. Blanks that are not should be filled in with "N/A" or a line drawn through the blank. Please print.

ATTACHMENTS: Please attach the following items to this report form and indicate with an "X" in box.

1. All Chain-of-Custody Forms	X
2. Standard Reference Toxicant (SRT) Reports attached. 2 SRT Reports attached.	X
3. All Raw Data (Bench Sheets) Pertaining to the Tests (i.e., all physical, chemical and biological measurements)	X
4. All Result Calculations	X

Facility/ Industry/ Client Name and address: **Reiss Environmental, 2487 Aloma Ave., Ste. 200, Winter Park, FL 32792, PO# 1906**

NPDES Number: N/A

County: N/A

Non-NPDES (1) X Yes

Project: Pilot Study

Dates Test(s) Conducted:

Name, Address, & Phone Number of Consultant Company: **Marinco Bioassay Laboratory, Inc. (MBL), 4569 Samuel Street Sarasota, Florida 34233, (941) 925-3594, Certification #E84191, Contact: Jason Weeks Laboratory Director or Lisa Rouwenhorst QA/QC Officer**

Start Date: 07/29/2003

End Date: 08/02/2003

Start time: 1625

Name(s) of Person(s) Conducting Test(s):(Printed): **Dubravka Mihajlovic, Lisa Rouwenhorst, Smiljana Kerkez, Katie Gray, and Marlena Beck**

QA/QC Officer/Reviewer: Signature

Date: 8/12/03

Laboratory Report #/ Project #: 030740

Sampler's Name: (Print) N/A

Routine Test X Additional N/A For failed routine test dated: N/A

Samples

#	Date and Time Collected	Lab Sample #	Sample Type: Grab or Composite	Arrival Temp oC	Initial Residual Chlorine (mg/L)	Lab Dechlorination	Chemical Used
1	07/28/2003 1100	030740-1	Grab	4	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------
--	----------	----------	----------	---	-------	------	-------

Type of Refrigerant Used for Sample Transportation: X Wet Ice, N/A Blue Ice, N/A Other (Describe)

Samples Delivered By: N/A Bus, N/A Hand, X Common Carrier

Samples Aerated: N/A Yes (Describe) X No

Samples Filtered: N/A Yes (Describe) X No

Provide Description: **Non-compliance test.**

(1) If toxicity testing data are reported for any project other than permit compliance testing, mark "yes" and identify the reason that toxicity data are being submitted, e.g., Consent Order, ambient monitoring, mixing zone evaluation.

This Page Last Edited By: Diane Thornton on: 08/04/2003

Summary of Test Conditions

Type of Test (1)	Test Conc. (% Effluent) (2)	Age of Test Organism	Test Species Used (3)	Amount & Type Food	How Often Fed	Test Chamber Volume	Volume of Effluent Used	Type of Chamber	# of Organism/ Chamber	# of Replicates	Temp Range (Degrees Celsius)
D	0, 6.25, 12.5, 25, 50, 100	4 days	MS	0.03 mL of 1200 Artemia nauplii/0.1 mL per replicate	Twice daily	1000 mL	200 mL	Beaker	10	2	24-25
D	0, 6.25, 12.5, 25, 50, 100	12 days	SS	0.08 mL of 1200 Artemia nauplii/0.1 mL per replicate	Once at renewal	1000 mL	250 mL	Beaker	10	2	24-25
-	----------	------	--	----------	----------	------	------	----------	------	--	-----
-	----------	------	--	----------	----------	------	------	----------	------	--	-----
-	----------	------	--	----------	----------	------	------	----------	------	--	-----

G. Other (1): N/A

Temperature Readings Were: N/A Single N/A Multiple X Continuous

Description of Control Water: Synthetic Seawater (Deionized Water + HW Marinemix)

Photoperiod During Test: 16 Hrs. Light : 8 Hrs. Dark

Reference Toxicant Data (4)

Name of Toxicant	Dates of Test Begin and End	Species (3)	In-House or Commercially Obtained	LC50/IC25
SDS	07/30/2003-08/03/2003	MS	In-House	20.3 mg/L SDS
SDS	07/30/2003-08/03/2003	SS	In-House	14.0 mg/L SDS
----------	----------	---------	----------	----------
----------	----------	---------	----------	----------
----------	----------	---------	----------	----------

(1) Please fill the "Type of Test" Box with the Appropriate Letter:
- **A.** 48-Hr/Non-Renewal/Single Concentration (Screen)
- **B.** 48-Hr/Non-Renewal/Multi-Concentration (Definitive)
- **C.** 96-Hr/Renewed Every 48-Hrs/Single Concentration (Screen)
- **D.** 96-Hr/Renewed Every 48-Hrs/Multi-Concentration (Definitive)
- **E.** 7-Day Chronic/Single Concentration (Screen)/Renewed Daily
- **F.** 7-Day Chronic/Multi-Concentration (Definitive)/Renewed Daily
- **G.** Other - Describe in the "G" Box

(2) List all concentrations of effluent used (i.e., 0%, 6.25%, 12.5%, 25%, 50%, 100%)

(3) Write Appropriate Letters for the following species in this column:
- CD Ceriodaphnia dubia
- FM Pimephales promelas (fathead minnow)
- SS Menidia beryllina (inland silverside)
- MS Mysidopsis bahia (mysid shrimp)
- DP Daphnia pulex
- DM Daphnia magna
- CL Cyprinella leedsi (bannerfin shiner)
- Other - Please Describe _____

(4) Attach all reference toxicant raw data and control charts for each organism/reference toxicant used for the test.

QA/QC Officer/Reviewer: Signature [signature] Date: 8/12/03

This Page Last Edited By: Diane Thornton on: 08/04/2003

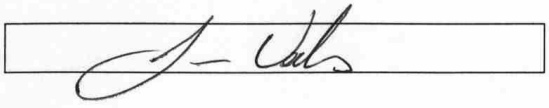
ACUTE Test Results.
Test conducted in accordance with EPA/600/4-90/027F.

Test Species	Test Concentration (2) (% Effluent)	Sample # (3)	% Mortality 24 Hrs (4)	% Mortality 48 Hrs (4)	% Mortality 96 Hrs (4)	LC50 (5)
MS Control	0	----------	-----	-----	0	------
MS	6.25, 12.5, 25, 50, 100	030740-1	-----	-----	-------	> 100% *
----------	----------	----------	-----	-----	-------	------
SS Control	0	----------	-----	-----	0	------
SS	6.25, 12.5, 25, 50, 100	030740-1	-----	-----	-------	> 100% *
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------
----------	----------	----------	-----	-----	-------	------

(1) List % control mortality in appropriate column (48 or 96 hr.) for organisms (use abbreviations shown on footnote 3, Page 2) that you list under the word "Control."
(2) List all concentrations of effluent used (i.e., 0%, 6.25%, 12.5%, 25%, 50%, 100%).
(3) Record number that corresponds with the number of the sample in the "Date and Time Collected" column in sample section on Page 1.
(4) List % Mortality for each organism and control if you are conducting a single concentration (Screen) test.

Species	LC50 (6)
--	----
--	----
--	----
--	----

(5) If multi-concentration (Definitive) tests are conducted on grab or composite samples, record the calculated LC50 in this column for each sample. Enter "N/A" in all % Mortality columns and LC50 box at bottom of this table.
(6) If a single concentration (Screen) test is conducted and >50% mortality occurs in any one of the four grab or composites, record <100% in this box. If <=50% mortality occurs in all four grabs or composites, record >100% in this box. Draw a line through the LC50 column in above table.
F = Flagged data, see page 4.
* No statistical test was used in endpoint determination as the data either did not appropriately fit the requirements of any point estimate techniques presented in EPA/600/4-90/027F or these methods provided an unrealistic or unrealiable result as demonstrated herein.

QA/QC Officer/Reviewer: Signature  Date: 8/12/03

This Page Last Edited By: Diane Thornton on: 08/04/2003

Specify if samples DO NOT meet NELAC standards:	
Standard violation	**Yes/No**
Improper container	No
36-hour holding time exceeded	No
Temperature above 6 degrees Celsius	No

Specify any deviations from, additions to, or exclusions from the test method or any non-standard conditions that may have affected the quality of the results, and include any data qualifiers.

All calculated statistical endpoints were calculated using ToxCalc version 5.0.21 - Tidepool Scientific Software.
The results contained in this report relate only to the items tested or to the samples as received by the laboratory. MBL certifies the results contained in this report meet NELAC standards.
This report shall not be reproduced except in full, without the written approval of MBL.

QA/QC Officer/Reviewer: Signature  Date: 8/12/03

This Page Last Edited By: Diane Thornton on: 08/04/2003

Page 5 of 12.

SURVIVAL BENCH SHEET

Project #: 030740 **Test Start:** 7/29/03 1625

Test Organism: Mysidopsis bahia **Test End:** 8/2/03 1523

Organism Age: 4days **Brood #:** MS 030725

Concentration %	Sample Number	Survival: Replicate A					Survival: Replicate B					A & B %
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	
100	030740-1	10	10	10	10	10	10	10	10	10	10	100
50		10	10	10	10	10	10	10	10	10	10	100
25		10	10	10	10	10	10	10	10	10	10	100
12.5		10	10	10	10	10	10	10	10	10	10	100
6.25		10	10	10	10	10	10	10	10	10	10	100
Control		10	10	10	10	10	10	10	10	10	10	100
Organisms Fed AM		— DM 1700	MLB DM 1655	MLB 0854 DM 1720	LR 0854 DB 1655	LR 0844 —	— DM 1700	MLB DM 1655	MLB 0854 DM 1720	LR 0854 DB 1655	LR 0844 —	—
Organisms Fed PM												
0 Hours started/checked by:		DM MLB	SK	SK	MLB	LR	DM MLB	SK	SK	MLB	LR	LR
24, 72, 96 Hours counted by:												
48 Hours renewed/cleaned by:												

Comments or Corrections: _____

Reviewed by: DT

Date: 08/04/03

STATIC RENEWAL ACUTE TOXICITY TEST
PHYSICAL AND CHEMICAL MEASUREMENTS

Project #: 030740 **Test Start:** 7/29/03 1625

Test Organism: Mysidopsis bahia **Test End:** 8/3/03 1523 DSM

Effluent Concentration %	Sample Number	Dissolved Oxygen (mg/L)					pH				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	030740-1	5.9	5.9	4.1/6.3 ①	5.9	6.0	7.9	8.0	8.0/7.9	8.0	8.1
50.0		6.4	5.7	3.9/6.3	5.9	6.0	7.9	8.0	7.8/7.8	7.9	8.0
25.0		6.5	5.5	3.9/6.3	5.9	5.9	7.8	7.9	7.7/7.7	7.8	7.9
12.5		6.5	5.3	4.1/6.3	5.1	5.0	7.7	7.8	7.7/7.7	7.7	7.7
6.25		6.5	5.3	4.2/6.3	5.9	6.0	7.7	7.8	7.7/7.6	7.7	7.9
Control		6.5	5.2	4.1/6.3	5.8	5.9	7.7	7.7	7.6/7.6	7.7	7.8
Measured by:		DM	SK	SK/SK	MB	LR	DM	SK	SK/SK	MB	LR

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					Salinity				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	030740-1	25	24	24/25	24	24	41.5	42.6	44.0/41.5	42.7	44.2
50.0		25	24	24/25	24	24	41.5	42.6	44.0/41.5	42.7	44.5
25.0		25	24	24/25	24	24	41.5	42.5	43.9/41.5	42.8	44.8
12.5		25	24	24/25	24	24	41.5	42.5	44.0/41.4	42.7	44.2
6.25		25	24	24/25	24	24	41.5	42.5	44.0/41.4	42.9	44.8
Control		25	24	24/25	24	24	41.4	42.3	43.6/41.4	42.8	44.3
Measured by:		DM	SIC	SK/SK	MB	LR	DM	SK	SK/SK	MB	LR

Comments or corrections: ① Aeration started on all Mysidopsis bahia replicates at ~100 bubbles/min DM 7/31/03 0925

Reviewed by: DT

Date: 08/04/03

Page 1 of 12.

SURVIVAL BENCH SHEET

Project #: 030740 **Test Start:** 7/29/03 1610

Test Organism: Menidia beryllina **Test End:** 8/2/03 1524 UR 8/0/03

Organism Age: 12days **Brood #:** SS 030717

Concentration %	Sample Number	Survival: Replicate A					Survival: Replicate B					A & B %
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	
100	030740-1	10	10	10	10	10	10	10	10	10	9	95
50		10	10	10	10	10	10	10	10	10	10	100
25		10	10	10	10	10	10	10	10	10	10	100
12.5		10	10	10	10	10	10	10	10	10	10	100
6.25		10	10	10	10	10	10	10	10	10	10	100
Control		10	10	10	10	10	10	10	10	10	10	100
Organisms Fed AM / PM		-/-	-/-	MB 0854 / -	-/-	-/-	-/-	-/-	MB 0854 / -	-/-	-/-	-
0 Hours started/checked by: 24, 72, 96 Hours counted by: 48 Hours renewed/cleaned by:		MM / KG	SK	SK	MB	UR	MM / KG	SK	SK	MB	UR	UR

Comments or Corrections: _____

Reviewed by: DT

Date: 08/04/03

MB. #0022 Ver. #3

STATIC RENEWAL ACUTE TOXICITY TEST
PHYSICAL AND CHEMICAL MEASUREMENTS

Project #: 030740 **Test Start:** 7/29/03 1610

Test Organism: Menidia beryllina **Test End:** 8/3 (2nd 8/4) 03 1521

Effluent Concentration %	Sample Number	Dissolved Oxygen (mg/L)					pH				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	030740-1	5.9	5.7	4.5/6.3	6.0	5.8	7.9	8.0	8.0/7.9	8.1	8.1
50.0		6.4	5.2	3.5/6.3	5.7	5.4	7.9	7.9	7.8/7.8	7.9	7.9
25.0		6.5	5.0	3.3/6.3	5.6	5.4	7.8	7.8	7.7/7.7	7.8	7.8
12.5		6.5	4.7	3.5/6.3	5.8	5.4	7.7	7.8	7.7/7.7	7.8	7.8
6.25		6.5	4.7	3.3/6.3	5.8	5.9	7.7	7.7	7.6/7.6	7.7	7.8
Control		6.5	4.8	3.4/6.3	5.4	5.4	7.7	7.7	7.6/7.6	7.7	7.7
Measured by:		DM	SK	SK/SK	MB	LR	DM	SK	SK/SK	MB	LR

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					Salinity				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	030740-1	25	24	24/25	24	24	41.5	42.2	43.5/41.5	42.5	43.7
50.0		25	24	24/25	24	24	41.5	42.4	43.4/41.5	42.4	43.6
25.0		25	24	24/25	24	24	41.5	42.3	43.5/41.5	42.5	43.5
12.5		25	24	24/25	24	24	41.5	42.2	43.5/41.4	42.5	43.5
6.25		25	24	24/25	24	24	41.5	42.4	43.6/41.4	42.6	44.0
Control		25	24	24/25	24	24	41.4	42.0	43.3/41.4	42.4	43.5
Measured by:		DM	SK	SK/SK	MB	LR	DM	SK	SK/SK	MB	LR

Comments or corrections: ① Aeration started on all Menidia beryllina replicates at ~ 100 bubbles/min DM 7/31/03 0920

Reviewed by: DT

Date: 08/04/03

SAMPLE/CONTROL WATER INFORMATION BENCH SHEET

Project #: 030740

Control Water and Sample Analysis

	Laboratory Number	Alkalinity (mg/L)	Date	Measured by:	Hardness (mg/L)	Date	Measured by:	Chlorine (mg/L)	Date	Measured by:	Cond. (mS/cm)*	Date	Measured by:
Initial Sample Analysis	030740-1										61.7	7/29/03	DM
Control Water – Initial	SW030724A										sal=41.4	7/29/03	DM
Control Water – Renewal	SW030724A										sal=41.4	7/31/03	SK

*Conductivity values indicated at a reference temperature of 25 degrees celsius. Values in this column for salt-control-water, SWyymmdd, are for salinity determined at the time of initial use in the test.

Sample Aeration Records Table

Sample #	Initial D.O. (mg/L)	Aeration Duration (min.)	Aeration Rate (ml/min.)	Final D.O. (mg/L)	Aerated by: Initials/Date/Time/Volume
030740-1	5.3	N/A	N/A	N/A	DM 7/29/03 1520
030740-1	6.3	N/A	N/A	N/A	SK 7/31/03 1101

Comments or corrections: _____

Reviewed by: DT

Date: 08/04/03

SAMPLE.FRP Ver. #3

Page 10 of 12.

ACUTE TEST CONDITIONS INFORMATION BENCH SHEET

Project #: 030740 **Client:** Reiss Environmental

Test type: 96 hr @MS, SS def. **Test run in Environmental Chamber #:** 1

Species Code (1)	Receipt Date and Supplier of Organism (if commercially obtained)	Init.	Amount & Type of Food (2)	Init.	How Often Fed (3)	Init.	Test Chamber Vol. (mL)	Init.	Vol. of Effluent Used (mL)	Init.	Type of Chamber (4)	Init.
MS	N/A	LR	D	SB	T	SB	1000	LR	200	LR	B	LR
SS	N/A	LR	D	MB	R	MB	1000	LR	250	LR	B	LR

(1) CD Ceriodaphnia dubia
FM Pimephales promelas (fathead minnow)
SS Menidia beryllina (inland silverside)
MS Mysidopsis bahia (mysid shrimp)
DP Daphnia pulex
DM Daphnia magna
CL Cyprinella leedsi (bannerfin shiner)
Other - Please Describe _____

(2) Please fill the "Amount & Type of Food" Box with the appropriate letter:
'A' 0.2 mL Selenastrum, 0.2 mL YCT
'B' 1.4 mL Selenastrum/200 mL of sample, 1.4 mL YCT/200 mL of sample
'C' 0.1 mL conc. Artemia nauplii
'D' 0.03 mL of 1200 Artemia nauplii/0.1 mL per replicate
'E' 0.04 mL of 1200 Artemia nauplii/0.1 mL per replicate
'F' 0.06 mL of 1200 Artemia nauplii/0.1 mL per replicate
'G' 0.07 mL of 1200 Artemia nauplii/0.1 mL per replicate
'O' Other 0.05mL of 1200Artemia/0.1mL per rep.

(3) Please fill the "How Often Fed" box with the appropriate letter:
'R' Once, at least two hours before renewal
'D' Once daily
'T' Twice daily
'O' Other _____

(4) Please fill the "Type of Chamber" box with the appropriate letter:
'B' Plastic Beaker
'M' Plastic Medicine Cup
'P' Plastic Cup
'G' Glass Beaker
'C' Plastic Container
'O' Other _____

Photoperiod: [LR] 16 hours Light/8 hours dark
[—] Other —

Test(s) conducted in accordance with EPA/600/4-90/027F.

Randomization version: 3

Physical and Chemical Measurement Equipment

Equipment type	Test start	24 hours	48 hours	72 hours	96 hours
Thermometer number (A)	A	A	A/A	A	A
DO Meter (B)	3	3	3/3	3	3
pH Meter (C)	7	7	7/7	7	7
Conductivity meter (D)	10	10	10/10	10	10
Freshwater cond. checked by	—	—	—/—	—	—
Used by (Initials)	MM	SK	SK/SK	MB	LR

(A)Thermometer number is the serial number or designated number on thermometer.
(B)DO Meters: "3" Orion 830
"4" Hach Sension 6
"5" Orion 830A
"6" Orion 820
(C)pH Meters "7" Hach Sension 2
"8" Orion 290A
"9" Orion 720
(D)Conductivity "10" Orion 160
"11" Orion 126
"O" Other _____

Comments or Corrections: _____

Reviewed by: D

Date: 08/04/03

MBL #0026a. Ver. 10

Report Page 11 of 12.

Marinco Bioassay Laboratory

4569 Samuel Street · Sarasota, FL 34233 · Phone: (941) 925-3594 · Fax: (941) 922-3874

Chain of Custody Record

Please use black ink only

Client: Reiss Environmental Permit #:

Samplers (Print Names):

Sample Containers

1 qt.	2 qt.	1 Gal.
		1

Sample Cooler #: 1614

Tests Required

Acute: 96hr @ MS.SS def.

Chronic:

Client Provided Information | **Lab Use Only**

TRC	Location	Sample ID#	Date of Sampling	Time of Sampling	Grab or Composite	Number of Bottles	Sample on Ice?	MBL Number (lab use only)	Arrival Temp.
			7/28/03*	11:00*				0307401	4°C
								Arrival sal = 42.0 ppt	
			*Information taken from the sample bottle 7/29/03						

Sampling Kit Transfers

Relinquished By:	Received By:	Date	Time	Count
MBL: Diane Thornton	Carrier: Fed Ex Ground	07/15/03	1400	1
Carrier: Fed Ex Ground	Client:			

Please refer to the back of this page for instructions and examples.

Sample Transfers

Relinquished By:	Received By:	Date	Time	Count
Person's Name:	Person's Name: Fed Ex			
Facility Name:	Facility Name:			
Person's Name: Fed Ex	Person's Name: Lisa Rauwenhorst	7/29/03	0940	1
Facility Name:	Facility Name: MBL			
Person's Name:	Person's Name:			
Facility Name:	Facility Name:			
Person's Name:	Person's Name:			
Facility Name:	Facility Name:			
Person's Name:	Person's Name:			
Facility Name:	Facility Name:			

Shipped via : Fed Ex Busbill/Airbill #: 7922 9483 8325

MBL #0009. Ver. #10

INTERNAL CHAIN OF CUSTODY
MARINCO BIOASSAY LABORATORY, INC.
Acute Toxicity Test

Project # 030740

Sample expiration date/time 7/29/03 2300

Sample #(s)	030740-1	030740-1
Procedure	**Test Start**	**Test Renewal**
Sample(s) checked in by Initials/Date/Time	LR 7/29/03 0940	N/A
Sample(s) warmed by Initials/Date/Time	DM 7/29/03 1515	SK 7/31/03 1100
Total Residual Chlorine measured by Initials/Date/Time	N/A	N/A
Sample(s) salted to test salinity using HW Marinemix by: Initials/Date/Time	N/A	N/A
Dilutions prepared by: Initials/Date/Time	DM 7/29/03 1540	SK 7/31/03 1115
Test Start-test started by: Test renewal-test renewed by: Initials/Date/Time	DM 7/29/03 1625	SK 7/31/03 1150
Remaining sample(s) returned to refrigerator by: Initials/Date/Time	DM 7/29/03 1540	~~N/A~~ SK 7/31/03 ~~SK 7/31/03 1115~~
Samples disposed of by & disposal method Initials/Date/Time	N/A	030740-1 Sample ~~consumed in test~~ N/A ~~SK 7/31/03 1115~~ SK 7/31/03

All samples are stored in the laboratory refrigerator from just above freezing to 6 degrees Celsius unless noted on this Internal chain of custody.

Comments: _____

Reviewed by DT 08/04/03

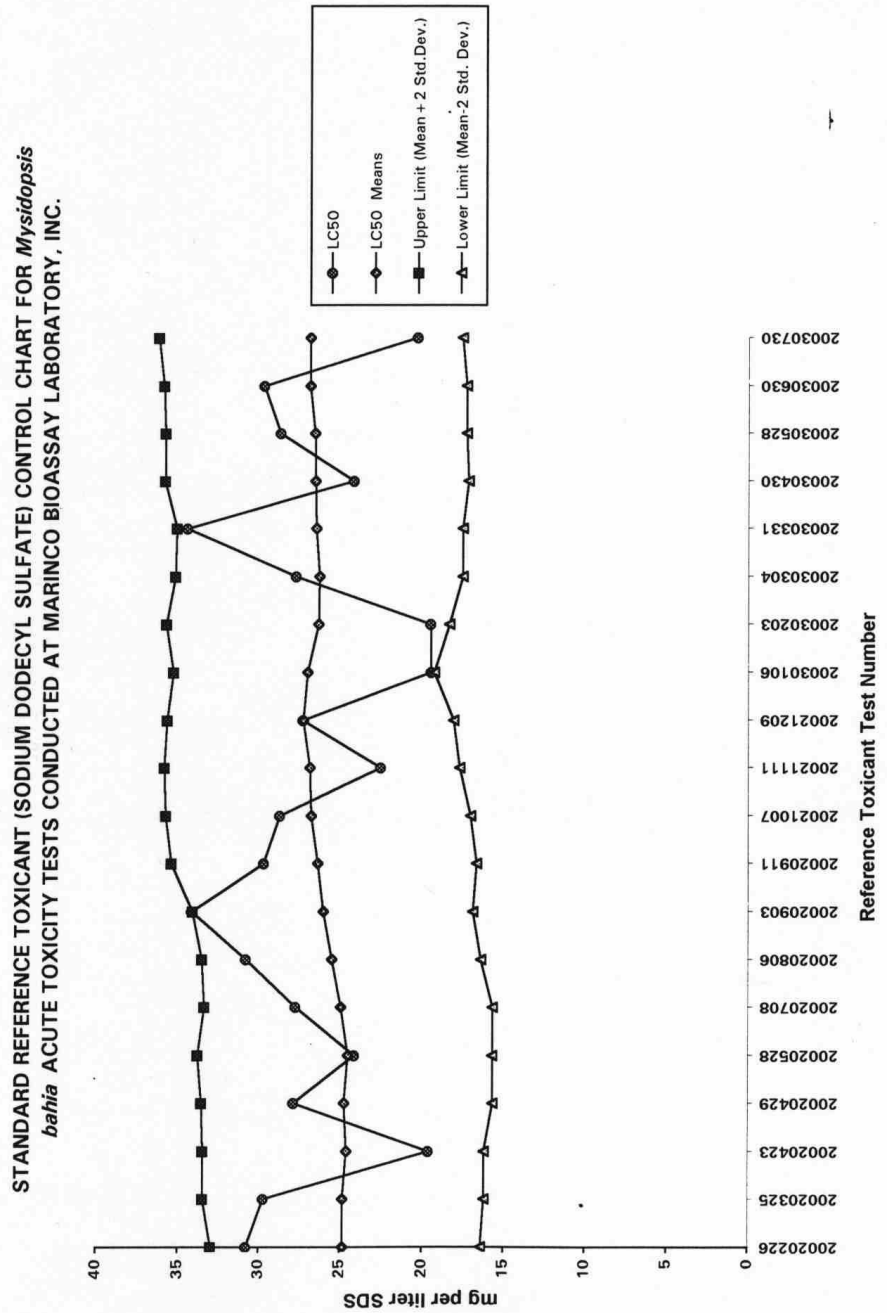
MBL#ac-int Ver#4

***Mysidopsis bahia* Acute Standard Reference Toxicant (SRT) Report.**

This quality control test was conducted by Marinco Bioassay Laboratory, Inc. personnel using Whole Effluent Toxicity (WET) Test method EPA/600/4-90/027F

SRT Test No. 030730MSACSRT

Reviewed by: Diane Thornton Date: 08/04/03


STANDARD REFERENCE TOXICANT (SODIUM DODECYL SULFATE) CONTROL CHART FOR *Mysidopsis bahia* ACUTE TOXICITY TESTS CONDUCTED AT MARINCO BIOASSAY LABORATORY, INC.
LC50
LC50 Means
Upper Limit (Mean + 2 Std.Dev.)
Lower Limit (Mean-2 Std. Dev.)
mg per liter SDS
0
5
10
15
20
25
30
35
40
Reference Toxicant Test Number
20020226
20020325
20020423
20020429
20020528
20020708
20020806
20020903
20020911
20021007
20021111
20021209
20030106
20030203
20030304
20030331
20030430
20030528
20030630
20030730

Acute Fish Test-96 Hr Survival

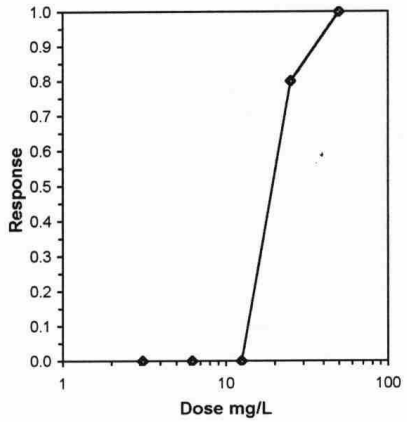
Start Date:	07/30/2003	Test ID:	030730MSACSRT	Sample ID:	50.0 mg/L SDS
End Date:	08/03/2003	Lab ID:	MBL-Marinco Bioassay Lab.	Sample Type:	SDS-Sodium dodecyl sulfate
Sample Date:		Protocol:	600490027F-EPA Acute Method	Test Species:	*MY-Mysidopsis bahia*
Comments:	This analysis was performed by Dubravka Mihajlovic at MBL.				

Conc-mg/L	1	2
Control	1.0000	1.0000
3.125	1.0000	1.0000
6.25	1.0000	1.0000
12.5	1.0000	1.0000
25	0.1000	0.3000
50	0.0000	0.0000

			Transform: Untransformed					Number	Total
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Control	**1.0000**	1.0000	1.0000	1.0000	1.0000	0.000	2	0	20
3.125	**1.0000**	1.0000	1.0000	1.0000	1.0000	0.000	2	0	20
6.25	**1.0000**	1.0000	1.0000	1.0000	1.0000	0.000	2	0	20
12.5	**1.0000**	1.0000	1.0000	1.0000	1.0000	0.000	2	0	20
25	**0.2000**	0.2000	0.2000	0.1000	0.3000	70.711	2	16	20
50	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.000	2	20	20

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	20.306	17.938	22.987
5.0%	19.914	17.421	22.764
10.0%	19.593	17.088	22.466
20.0%	19.278	17.498	21.239
Auto-0.0%	**20.306**	**17.938**	**22.987**



Reviewed by: DT

SURVIVAL BENCH SHEET

Project #: 030730MSACSET **Test Start:** 7/30/03 1353

Test Organism: Mysidopsis bahia **Test End:** 8/3/03 1344

Organism Age: 4 days **Brood #:** MS030726

Concentration %	Sample Number	Survival: Replicate A					Survival: Replicate B					A & B %
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	
100	50.0mg/LSDS	10	0	—	—	—	10	0	—	—	—	0
50		10	1	1	1	1	10	3	3	3	3	20
25		10	10	10	10	10	10	10	10	10	10	100
12.5		10	10	10	10	10	10	10	10	10	10	100
6.25		10	10	10	10	10	10	10	10	10	10	100
Control		10	10	10	10	10	10	10	10	10	10	100
Organisms Fed AM		—	MS 0854	VR 0830	VR 0844	DM 0810	—	MS 0854	VR 0830	VR 0844	DM 0810	—
Organisms Fed PM		DM 1655	DM 1720	1655	VR 1500	—	DM 1655	DM 1720	1655	VR 1500	—	
0 Hours started/checked by:		GB PM	SK	LR 1444	LR	PM	GB PM	SK	LR 1444	LR	PM	PM
24, 72, 96 Hours counted by:												
48 Hours renewed/cleaned by:												

Comments or Corrections: _____

Reviewed by: _____

Date: 08/04/03

Page 5 of 7

STATIC RENEWAL ACUTE TOXICITY TEST
PHYSICAL AND CHEMICAL MEASUREMENTS

Project #: 1B0B0MSACSET **Test Start:** 7/30/03 1353

Test Organism: Mysidopsis bahia **Test End:** 8/3/03 1344

Effluent Concentration %	Sample Number	Dissolved Oxygen (mg/L)					pH				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	50.0mg/L SOS	7.4	4.0	—			7.3	7.1	—		
50.0		7.4	4.3	6.4/6.8	5.7	6.8	7.4	7.0	7.5/7.5	7.4	7.6
25.0		7.4	5.3	6.0/6.8	5.3	5.3	7.4	7.2	7.5/7.5	7.4	7.5
12.5		7.4	6.2	5.2/6.8	5.1	5.2	7.4	7.4	7.4/7.5	7.4	7.4
6.25		7.4	6.2	4.3/6.8	5.1	5.3	7.4	7.4	7.3/7.5	7.4	7.4
Control		7.2	5.9	4.2/6.8	5.2	5.1	7.3	7.4	7.2/7.5	7.4	7.4
Measured by:		AB	SK	MB/LR	LR	DM	AB	SK	MB/LR	LR	DM

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					Salinity				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	50.0mg/L SOS	24	25	—			20.0	20.5	—		
50.0		24	25	24/25	24	24	20.0	20.5	21.2/20.0	20.9	22.3
25.0		24	25	24/25	24	24	20.0	20.5	21.3/20.0	20.8	21.9
12.5		24	25	24/25	24	24	20.0	20.5	21.2/20.0	20.9	22.6
6.25		24	25	24/25	24	24	20.0	20.5	21.1/20.0	20.6	21.5
Control		24	25	24/25	24	24	20.0	20.6	21.0/19.9	20.5	21.3
Measured by:		AB	SK	MB/LR	LR	DM	AB	SK	MB/LR	LR	DM

Comments or corrections: _____

Reviewed by: DM

Date: 08/04/03

MBL #0006, Ver. 4

SRT Tracking Sheet

Test ID: 030730MSAASRT **Test LC50:** 20.3mg/L SDS

Test Species: Mysidopsis bahia **Test NOEC:** _____

Test Dates : 7/30/03 to 8/3/03 **Test IC25:** _____

SRT Solution Data

Test Concentration and Toxicant: 50.0mg/L SDS lot# 101K0036

Mass of Toxicant from Balance Log (g)	Measured by Init./Date	Volume Mixed (L)	Mixed by Init./Date	Cond. (mS/cm)	Measured by Init./Date	Balance Used to measure toxicant Init./date
0.05006	AB 7/30/03	1.0	AB 7/30/03	Sal. = 20.0	AB 7/30/03	Mettler AB 7/30/03
0.05016	LR 8/1/03	1.0	LR 8/1/03	Sal = 20.0	LR 8/1/03	Mettler LR 8/1/03

Control and Dilution Waters

Laboratory Number	Alkalinity (mg/L)	Measured by Init./Date	Hardness (mg/L)	Measured by Init./Date	Cond. (mS/cm)	Measured by Init./Date
SW030724B					Sal. = 20.0	AB 7/30/03
SW030728B					Sal. = 20.0	AB 7/30/03
SW030724A					Sal = 19.9	LR 8/1/03

Comments or Corrections: _____

Reviewed by: DT

Date: 08/04/03

MBL #0031 Ver. #9

Page 1 of 1.

ACUTE TEST CONDITIONS INFORMATION BENCH SHEET

Project #: 030308MSAASRT **Client:** —

Test type: MS 96hr. @ def. **Test run in Environmental Chamber #:** 1

Species Code (1)	Receipt Date and Supplier of Organism (if commercially obtained)	Init.	Amount & Type of Food (2)	Init.	How Often Fed (3)	Init.	Test Chamber Vol. (mL)	Init.	Vol. of Effluent Used (mL)	Init.	Type of Chamber (4)	Init.
MS	—	MB	D	DM	T	DM	1000	MB	250	MB	B	MB

(1) CD Ceriodaphnia dubia
FM Pimephales promelas (fathead minnow)
SS Menidia beryllina (inland silverside)
MS Mysidopsis bahia (mysid shrimp)
DP Daphnia pulex
DM Daphnia magna
CL Cyprinella leedsi (bannerfin shiner)
Other - Please Describe _____

(2) Please fill the "Amount & Type of Food" Box with the appropriate letter:
'A' 0.2 mL Selenastrum, 0.2 mL YCT
'B' 1.4 mL Selenastrum/200 mL of sample, 1.4 mL YCT/200 mL of sample
'C' 0.1 mL conc. Artemia nauplii
'D' 0.03 mL of 1200 Artemia nauplii/0.1 mL per replicate
'E' 0.04 mL of 1200 Artemia nauplii/0.1 mL per replicate
'F' 0.06 mL of 1200 Artemia nauplii/0.1 mL per replicate
'G' 0.07 mL of 1200 Artemia nauplii/0.1 mL per replicate
'O' Other _____

(3) Please fill the "How Often Fed" box with the appropriate letter:
'R' Once, at least two hours before renewal
'D' Once daily
'T' Twice daily
'O' Other _____

(4) Please fill the "Type of Chamber" box with the appropriate letter:
'B' Plastic Beaker
'M' Plastic Medicine Cup
'P' Plastic Cup
'G' Glass Beaker
'C' Plastic Container
'O' Other _____

Photoperiod: MB 16 hours Light/8 hours dark
— Other —

Test(s) conducted in accordance with EPA/600/4-90/027F.

Randomization version: 3

Physical and Chemical Measurement Equipment

Equipment type	Test start	24 hours	48 hours	72 hours	96 hours
Thermometer number (A)	A	A	A/A	A	A
DO Meter (B)	3	3	3/3	3	3
pH Meter (C)	7	7	7/7	7	7
Conductivity meter (D)	10	10	10/10	10	10
Freshwater cond. checked by	—	—	—/—	—	—
Used by (Initials)	GB	SK	MB/LR	LR	DM

(A)Thermometer number is the serial number or designated number on thermometer.
(B)DO Meters: "3" Orion 830
"4" Hach Sension 6
"5" Orion 830A
"6" Orion 820
(C)pH Meters "7" Hach Sension 2
"8" Orion 290A
"9" Orion 720
(D)Conductivity "10" Orion 160
"11" Orion 126
"O" Other _____

Comments or Corrections: _____

Reviewed by: DT

Date: 08/04/03

MBL #0026a. Ver. 10

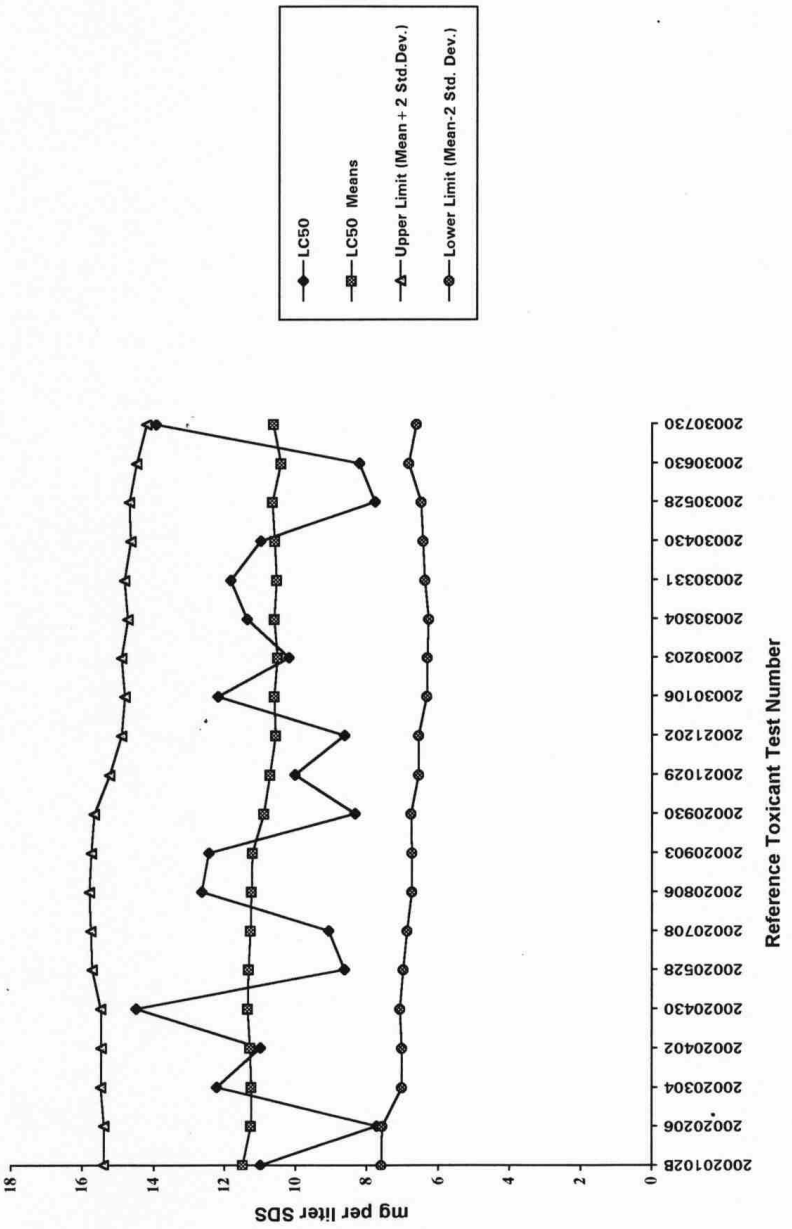
***Menidia beryllina* Acute Standard Reference Toxicant (SRT) Report.**

This quality control test was conducted by Marinco Bioassay Laboratory, Inc. personnel using Whole Effluent Toxicity (WET) Test method EPA/600/4-90/027F

SRT Test No. 030730SSACSRT

Reviewed by: Diane Thornton Date: 08/04/03

STANDARD REFERENCE TOXICANT (SODIUM DODECYL SULFATE) CONTROL CHART FOR *Menidia beryllina* ACUTE TOXICITY TESTS CONDUCTED AT MARINCO BIOASSAY LABORATORY, INC.



Acute Fish Test-96 Hr Survival

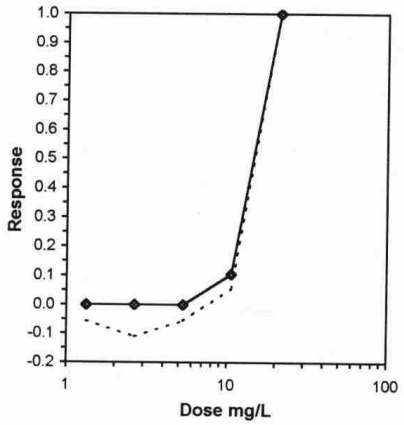
Start Date:	07/30/2003	Test ID:	030730SSACSRT	Sample ID:	21.25 mg/L SDS
End Date:	08/03/2003	Lab ID:	MBL-Marinco Bioassay Lab.	Sample Type:	SDS-Sodium dodecyl sulfate
Sample Date:		Protocol:	600490027F-EPA Acute Method	Test Species:	*MB-Menidia beryllina*
Comments:	This analysis was performed by Dubravka Mihajlovic at MBL.				

Conc-mg/L	1	2
Control	1.0000	0.8000
1.328	1.0000	0.9000
2.656	1.0000	1.0000
5.312	1.0000	0.9000
10.62	0.7000	1.0000
21.25	0.0000	0.0000

			Transform: Untransformed					Number	Total
Conc-mg/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Control	**0.9000**	1.0000	0.9000	0.8000	1.0000	15.713	2	2	20
1.328	**0.9500**	1.0556	0.9500	0.9000	1.0000	7.443	2	1	20
2.656	**1.0000**	1.1111	1.0000	1.0000	1.0000	0.000	2	0	20
5.312	**0.9500**	1.0556	0.9500	0.9000	1.0000	7.443	2	1	20
10.62	**0.8500**	0.9444	0.8500	0.7000	1.0000	24.957	2	3	20
21.25	**0.0000**	0.0000	0.0000	0.0000	0.0000	0.000	2	20	20

Trimmed Spearman-Karber

Trim Level	EC50	95% CL	
0.0%	13.965	12.698	15.359
5.0%	14.281	12.698	16.060
10.0%	14.420	12.144	17.124
20.0%	14.422	13.589	15.305
Auto-0.0%	**13.965**	**12.698**	**15.359**



Reviewed by: DT

SURVIVAL BENCH SHEET

Project #: 130B0SSACSET **Test Start:** 7/30/03 1615

Test Organism: Menidia beryllina **Test End:** 8/3/03 1550

Organism Age: 10 days **Brood #:** SS030720

Concentration %	Sample Number	Survival: Replicate A					Survival: Replicate B					A & B %
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	
100	21.25mg/L SS	10	0	—	—	—	10	0	—	—	—	
50		10	10	10	9	7	10	10	10	10	10	85
25		10	10	10	10	10	10	10	10	9	9	95
12.5		10	10	10	10	10	10	10	10	10	10	100
6.25		10	10	10	10	10	10	10	9	9	9	95
Control		10	10	10	10	10	10	10	9	9	8	90
Organisms Fed AM		—	—	LR 0854	—	—	—	—	LR 0854	—	—	—
Organisms Fed PM		—	—	—	—	—	—	—	—	—	—	—
0 Hours started/checked by:		LB PM	SK	LR 1434	LR	SK	LB PM	SK	LR 1434	LR	SK	SK
24, 72, 96 Hours counted by:												
48 Hours renewed/cleaned by:												

Comments or Corrections: _____

Reviewed by: DT

Date: 08/04/03

MBL #0022. Ver. #3

Page 5 of 7

STATIC RENEWAL ACUTE TOXICITY TEST
PHYSICAL AND CHEMICAL MEASUREMENTS

Project #: 030730SSAOSCT **Test Start:** 7/30/03 1615

Test Organism: Menidia beryllina **Test End:** 8/3/03 1550

Effluent Concentration %	Sample Number	Dissolved Oxygen (mg/L)					pH				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	2125mg/L SOS	7.3	3.3	-			7.3	7.0	-		
50.0		7.3	5.6	4.8/6.9	5.1	4.5	7.3	7.3	7.2/7.5	7.3	7.2
25.0		7.3	5.9	4.9/6.8	5.5	5.2	7.3	7.3	7.3/7.5	7.3	7.4
12.5		7.3	5.9	5.0/6.8	5.7	5.4	7.3	7.3	7.3/7.5	7.3	7.4
6.25		7.2	5.7	4.9/6.9	5.6	5.6	7.3	7.3	7.3/7.5	7.3	7.4
Control		7.2	5.7	5.1/6.8	5.8	5.5	7.3	7.3	7.3/7.5	7.4	7.4
Measured by:		SB	SK	MB/LR	LR	DM	SB	SK	MB/LR	LR	DM

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					salinity				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	2125mg/L SOS	24	25	-			20.0	20.7	-		
50.0		24	25	25/24	25	26	20.0	20.6	21.4/20.0	20.7	21.5
25.0		24	25	25/24	25	26	20.0	20.7	21.5/20.0	20.8	21.7
12.5		24	25	25/24	25	26	20.0	20.7	21.6/19.9	20.7	21.7
6.25		24	25	25/24	25	26	20.0	20.5	21.3/19.9	20.5	21.3
Control		24	25	25/24	25	26	20.0	20.7	21.4/19.9	20.7	21.7
Measured by:		SB	SK	MB/LR	LR	DM	SB	SK	MB/LR	LR	DM

Comments or corrections: _____

Reviewed by: DS

Date: 08/04/03

MBL #0006. Ver 4

Page 4 of 7

SRT Tracking Sheet

Test ID: 080805ACSRT **Test LC50:** 8814 13.9-14.0mg/L SDS

Test Species: Menidia beryllina **Test NOEC:** _____

Test Dates : 7/30/03 to 8/3/03 **Test IC25:** _____

SRT Solution Data

Test Concentration and Toxicant: 21.25mg/L SDS lot# 101K0036

Mass of Toxicant from Balance Log (g)	Measured by Init./Date	Volume Mixed (L)	Mixed by Init./Date	Cond. (mS/cm)	Measured by Init./Date	Balance Used to measure toxicant Init./date
0.02131	KB 7/30/03	1.0	KB 7/30/03	Sal. = 20.0	KB 7/30/03	Mettler KB 7/30/03
0.02120	LR 8/1/03	1.0	LR 8/1/03	sal = 19.9	LR 8/1/03	Mettler LR 8/1/03

Control and Dilution Waters

Laboratory Number	Alkalinity (mg/L)	Measured by Init./Date	Hardness (mg/L)	Measured by Init./Date	Cond. (mS/cm)	Measured by Init./Date
SW030724B					Sal. = 20.0	KB 7/30/03
SW030728B					Sal. = 20.0	KB 7/30/03
SW030724A					sal = 19.9	LR 8/1/03

Comments or Corrections: _____

Reviewed by: JT

Date: 08/04/03

MBL #0031 Ver. #9

Page 1 of 1.

ACUTE TEST CONDITIONS INFORMATION BENCH SHEET

Project #: 030730SSAQSRT **Client:** —

Test type: SS96hr. Rdef. **Test run in Environmental Chamber #:** 13 MB 7/30

Species Code (1)	Receipt Date and Supplier of Organism (if commercially obtained)	Init.	Amount & Type of Food (2)	Init.	How Often Fed (3)	Init.	Test Chamber Vol. (mL)	Init.	Vol. of Effluent Used (mL)	Init.	Type of Chamber (4)	Init.
SS	—	MB	O	UR	R	UR	1000	MB	250	MB	B	MB

(1) CD Ceriodaphnia dubia
FM Pimephales promelas (fathead minnow)
SS Menidia beryllina (inland silverside)
MS Mysidopsis bahia (mysid shrimp)
DP Daphnia pulex
DM Daphnia magna
CL Cyprinella leedsi (bannerfin shiner)
Other - Please Describe _____

(2) Please fill the "Amount & Type of Food" Box with the appropriate letter:
'A' 0.2 mL Selenastrum, 0.2 mL YCT
'B' 1.4 mL Selenastrum/200 mL of sample, 1.4 mL YCT/200 mL of sample
'C' 0.1 mL conc. Artemia nauplii
'D' 0.03 mL of 1200 Artemia nauplii/0.1 mL per replicate
'E' 0.04 mL of 1200 Artemia nauplii/0.1 mL per replicate
'F' 0.06 mL of 1200 Artemia nauplii/0.1 mL per replicate
'G' 0.07 mL of 1200 Artemia nauplii/0.1 mL per replicate
'O' Other 0.08mL of 1200 Artemia/0.1mL per rep.

(3) Please fill the "How Often Fed" box with the appropriate letter:
'R' Once, at least two hours before renewal
'D' Once daily
'T' Twice daily
'O' Other _____

(4) Please fill the "Type of Chamber" box with the appropriate letter:
'B' Plastic Beaker
'M' Plastic Medicine Cup
'P' Plastic Cup
'G' Glass Beaker
'C' Plastic Container
'O' Other _____

Photoperiod: MB 16 hours Light/8 hours dark
— Other —

Test(s) conducted in accordance with EPA/600/4-90/027F.

Randomization version: 4

Physical and Chemical Measurement Equipment

Equipment type	Test start	24 hours	48 hours	72 hours	96 hours
Thermometer number (A)	A	A	A/A	A	A
DO Meter (B)	3	3	3/3	3	3
pH Meter (C)	7	7	7/7	7	7
Conductivity meter (D)	10	10	10/10	10	10
Freshwater cond. checked by	—	—	—/—	—	—
Used by (Initials)	GB	SIC	MB/UR	UR	DT

(A)Thermometer number is the serial number or designated number on thermometer.
(B)DO Meters: "3" Orion 830
"4" Hach Sension 6
"5" Orion 830A
"6" Orion 820
(C)pH Meters "7" Hach Sension 2
"8" Orion 290A
"9" Orion 720
(D)Conductivity "10" Orion 160
"11" Orion 126
"O" Other _____

Comments or Corrections: _____

Reviewed by: DT

Date: 08/04/03

MBL #0026a. Ver. 10

APPENDIX C

Comparison of Concentrate Water Quality with Class II and III Surface Water Standards

COMPARISON OF CONCENTRATE WATER QUALITY WITH CLASS II AND III SURFACE WATER STANDARDS

	Units	CONCENTRATE QUALITY				Surface Water Standards (Bolded units are based on annual average)			Evaluation for Class II and III
		Sampling #1	Sampling #2	Sampling #3	Average	Class II	Class III (marine)	Units	
1. General									
Carboneous Biochemical Oxygen Demand (CBOD)	mg/L	< 2	< 2	< 2	< 2	--	--		--
Chemical Oxygen Demand (COD)	mg/L	340	360	260	320	--	--		--
Total Organic Carbon (TOC)	mg/L	19	19	20	19	--	--		--
Total Suspended Solids (TSS)	mg/L	11	58	10	26	--	--		--
Total Nitrogen (as N)	mg/L N	1.1	1.30	1.20	1.2	--	--		--
Total Phosphorus (as P)	mg/L P	0.19	< 0.03	< 0.03	0.08	0.10	0.10	ug/L	Class II and III Violation
Specific Conductivity	umohs/cm	69,000	64,000	62,000	65,000	--	--		--
pH	SU	7.8	8.20	7.90	8	background	background	Standard Units	No Violation
Bromide	mg/L	94	77.0	84	85	--	--		--
Color	PCU	15	20.0	15.0	17	--	--		--
Fecal Coliform	Ct/100 mL	< 1	< 1	< 1	< 1	--	--		--
Fluoride	mg/l	1.8	1.30	1.60	1.57	1.5	5.0		Class II Violation
Chloride	mg/L	28,000	23,000	25,000	25,333	--	--		--
Nitrate-Nitrite	mg/L N	0.01	< 0.01	< 0.01	< 0.01	--	--		--
Nitrogen, total organic (as N)	mg/L N	1.0	1.30	1.20	1.17	--	--		--
Oil and Grease (hexane extractable material)	mg/L	< 5	< 5	< 5	< 5	5.0	5.0	mg/L	No Violation
Phosphorus, orthophosphate	mg/L P	< 0.01	< 0.01	< 0.01	< 0.01	--	--		--
Alpha, gross	pCi/L	1.90	4.70	3.60	3.4	15	15	Picocuries/L	No Violation
Beta, gross	pCi/L					--	--		--
Radium, total	pCi/L	1.40	2.80	1.60	1.93	5.0	5.0	Picocuries/L	No Violation
Radium 226	pCi/L	1.80	2.10	0.90	1.60	--	--		--
Radium 228	pCi/L	< 0.3	1.80	1.30	1.1	--	--		--
Sulfate as SO4	mg/L	3,900	3,600	3,600	3,700	--	--		--
Sulfide as S	mg/L	< 0.1	0.20	< 0.1	0.1	--	--		--

Sulfite as SO3	mg/L	< 2	< 2	< 2	< 2	--	--		--
Surfactants	mg/L	0.083	0.08	0.11	0.09	--	--		--
Aluminum, total	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	1.5	1.5	mg/L	No Violation
Barium, total	mg/L	0.04	< 0.04	0.04	0.04	--	--		--
Boron, total	mg/L	3.1	3.10	3.60	3.27	--	--		--
Cobalt, total	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	--	--		--
Iron, total	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	0.30	0.30	mg/L	No Violation
Magnesium, total	mg/L	1,800	1,600	1,600	1,667	--	--		--
Molybdenum, total	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	--	--		--
Manganese, total	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	--	--		--
Tin, total	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	--	--		--
Titanium, total	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	--	--		--
2. Metals (total recoverable), cyanide and total phenols						--	--		--
Antimony	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	4300	4300	mg/L	No Violation
Arsenic	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	36	36	mg/L	No Violation
Beryllium	mg/L	0.00013	0.000011	< 0.00005	0.00006	**0.13**	**0.13**	ug/L	No Violation
Cadmium	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	9.3	9.3	ug/L	No Violation
Chromium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	--	--		--
Copper (chelation extraction)	ug/L	7.3	5.70	11.00	8.0	3.7	3.7	ug/L	Class II and III Violation
Lead	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	8.5	8.5	ug/L	No Violation
Mercury	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.025	0.025	ug/L	Class II and III Violation
Nickel (chelation extraction)	ug/L	6.0	3.30	2.90	4.1	8.3	8.3	ug/L	No Violation
Selenium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	71	71	ug/L	No Violation
Silver	mg/L	< 0.00025	< 0.00025	< 0.00025	< 0.00025	2.3	2.3	ug/L	No Violation
Thallium	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	6.3	6.3	ug/L	No Violation
Zinc	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	86	86	ug/L	No Violation
Cyanide	mg/L	< 0.005	< 0.005		< 0.005	1.0	1.0	ug/L	Class II and III Violation
Total phenolic compounds	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	--	--		--
3. Dioxin						--	--		
2,3,7,8-Tetra-chlorodibenzo-P-Dioxin (subcontract)	pg/L	NS	< 1	NS	< 1.00	--	--		--
4. GC Fraction - Volatile						--	--		

organic compounds									
Acrolein	ug/L	NS	< 5	NS	< 5.00	--	--		--
Acrylonitrile	ug/L	NS	< 5	NS	< 5.00	--	--		--
Benzene	ug/L	NS	< 0.5	NS	< 0.50	**71.28**	**71.28**	ug/L	No Violation
Bromoform	ug/L	NS	< 0.5	NS	< 0.50	**360**	**360**	ug/L	No Violation
Carbon tetrachloride	ug/L	NS	< 0.3	NS	< 0.30	**4.42**	**4.42**	ug/L	No Violation
Chlorobenzene	ug/L	NS	< 0.3	NS	< 0.30	--	--		--
Chlorodibromomethane	ug/L	NS	< 0.5	NS	< 0.50	**34**	**34**	ug/L	No Violation
Chloroethane	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
2-chloroethylvinyl ether	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
Chloroform	ug/L	NS	< 0.2	NS	< 0.20	**471**	**471**	ug/L	No Violation
Dichlorobromomethane	ug/L	NS	< 0.3	NS	< 0.30	**22**	**22**	ug/L	No Violation
Dichloro-difluromethane	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
1,1-dichloroethane	ug/L	NS	< 0.3	NS	< 0.30	--	--		--
1,2-dichloroethane	ug/L	NS	< 0.2	NS	< 0.20	--	--		--
Trans-1,2-dichloroethylene	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
1,1-dichloroethylene	ug/L	NS	< 0.5	NS	< 0.50	**3**	**3**	ug/L	No Violation
1,2-dichloropropane	ug/L	NS	< 0.3	NS	< 0.30	--	--		--
1,3-dichloropropylene	ug/L	NS	< 0.3	NS	< 0.30	--	--		--
Ethylbenzene	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
Methyl bromide	ug/L	NS		NS	#DIV/0!	--	--		#DIV/0!
Methyl chloride	ug/L	NS		NS	#DIV/0!	**471**	**471**	ug/L	#DIV/0!
Methylene chloride	ug/L	NS	< 0.5	NS	< 0.50	**1580**	**1580**	ug/L	No Violation
1,1,2,2-tetrachloroethane	ug/L	NS	< 0.3	NS	< 0.30	**11**	**11**	ug/L	No Violation
Tetrachloroethylene	ug/L	NS	< 0.2	NS	< 0.20	**9**	**9**	ug/L	No Violation
Toluene	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
1,1,1-trichloroethane	ug/L	NS	< 0.3	NS	< 0.30	--	--		--
1,1,2-trichloroethane	ug/L	NS	< 0.3	NS	< 0.30	--	--		--
Trichloroethylene	ug/L	NS	< 0.2	NS	< 0.20	**81**	**81**	ug/L	No Violation
Trichloro-fluromethane	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
Vinyl chloride	ug/L	NS	< 0.5	NS	< 0.50	--	--		--
5. GC/MS Fraction Acid-extractable compounds						--	--		

6. GC/MS Fraction Base-neutral compounds						--	--		
2-chlorophenol	ug/L	NS	< 10	NS	< 10	400	400	ug/L	No Violation
2,4-dichlorophenol	ug/L	NS	< 10	NS	< 10	790	790	ug/L	No Violation
2,4-dimethylphenol	ug/L	NS	< 10	NS	< 10	--	--		--
4,6-dinitro-o-cresol	ug/L	NS	< 50	NS	< 50	--	--		--
2,4-dinitrophenol	ug/L	NS	< 50	NS	< 50	14260	14260.00	ug/L	No Violation
2-nitrophenol	ug/L	NS	< 10	NS	< 10	--	--		--
4-nitrophenol	ug/L	NS	< 50	NS	< 50	--	--		--
Pentachlorophenol	ug/L	NS	< 10	NS	< 10	7.9	7.9	ug/L	Class II and III Violation
Phenol	ug/L	NS	< 10	NS	< 10	300	300	ug/L	No Violation
2,4,6-trichlorophenol	ug/L	NS	< 10	NS	< 10	**6.5**	**6.5**	ug/L	Class II and III Violation
Acenaphthene	ug/L	NS	< 10	NS	< 10	2700	2700	mg/L	No Violation
Acenaphthylene	ug/L	NS	< 10	NS	< 10	--	--	ug/L	--
Anthracene	ug/L	NS	< 10	NS	< 10	110000	110000	ug/L	No Violation
Benzidine	ug/L	NS	< 30	NS	< 30	--	--		--
Benzo(a)anthracene	ug/L	NS	< 10	NS	< 10	--	--		--
Benzo(a)pyrene	ug/L	NS	< 10	NS	< 10	--	--		--
3,4 benzofluoranthene	ug/L	NS	< 10	NS	< 10	--	--		--
Benzo(ghi)perylene	ug/L	NS	< 10	NS	< 10	--	--		--
Benzo(k)fluoranthene	ug/L	NS	< 10	NS	< 10	--	--		--
Bis (2-chloroethoxy) methane	ug/L	NS	< 10	NS	< 10	--	--		--
Bis (2-chloroethyl) ether	ug/L	NS	< 10	NS	< 10	--	--		--
Bis (2-chloroisopropyl) ether	ug/L	NS	< 10	NS	< 10	--	--		--
Bis (2-ethylhexyl) phthalate	ug/L	NS	< 10	NS	< 10	--	--		--
4-bromophenyl phenyl ether	ug/L	NS	< 10	NS	< 10	--	--		--
Butyl benzyl phthalate	ug/L	NS	< 10	NS	< 10	--	--		--
2-chloronaphthalene	ug/L	NS	< 10	NS	< 10	--	--		--
4-chlorophenyl phenyl ether	ug/L	NS	< 10	NS	< 10	--	--		--
Chrysene	ug/L	NS	< 10	NS	< 10	--	--		--
Di-n-butyl phthalate	ug/L	NS	< 10	NS	< 10	--	--		--
Di-n-octyl phthalate	ug/L	NS	< 10	NS	< 10	--	--		--
Dibenzo(a,h)anthracene	ug/L	NS	< 10	NS	< 10	--	--		--
1,2-dichlorobenzene	ug/L	NS	< 10	NS	< 10	--	--		--

1,3-dichlorobenzene	ug/L	NS	< 10	NS	< 10	--	--		--
1,4-dichlorobenzene	ug/L	NS	< 10	NS	< 10	--	--		--
3,3-dichlorobenzidine	ug/L	NS	< 10	NS	< 10	--	--		--
Diethyl phthalate	ug/L	NS	< 10	NS	< 10	--	--		--
Dimethyl phthalate	ug/L	NS	< 10	NS	< 10	--	--		--
2,4-dinitrotoluene	ug/L	NS	< 10	NS	< 10	**9.1**	**9.1**	ug/L	Class II and III Violation
2,6-dinitrotoluene	ug/L	NS	< 10	NS	< 10	--	--		--
1,2-diphenylhydrazine	ug/L	NS	< 10	NS	< 10	--	--		--
Fluoranthene	ug/L	NS	< 10	NS	< 10	370	370	ug/L	No Violation
Fluorene	ug/L	NS	< 10	NS	< 10	14000	14000	ug/L	No Violation
Hexachlorobenzene	ug/L	NS	< 10	NS	< 10	--	--		--
Hexachlorobutadiene	ug/L	NS	< 10	NS	< 10	**49.7**	**49.7**	ug/L	No Violation
Hexachlorocyclo-pentadiene	ug/L	NS	< 10	NS	< 10	--	--		--
Hexachloroethane	ug/L	NS	< 10	NS	< 10	--	--		--
Indeno(1,2,3-cd)pyrene	ug/L	NS	< 10	NS	< 10	--	--		--
Isophorone	ug/L	NS	< 10	NS	< 10	--	--		--
Naphthalene	ug/L	NS	< 10	NS	< 10	--	--		--
Nitrobenzene	ug/L	NS	< 10	NS	< 10	--	--		--
N-nitrosodi-n-propylamine	ug/L	NS	< 10	NS	< 10	--	--		--
N-nitrosodimethylamine	ug/L	NS	< 10	NS	< 10	--	--		--
N-nitrosodiphenylamine	ug/L	NS	< 10	NS	< 10	--	--		--
Phenanthrene	ug/L	NS	< 10	NS	< 10	--	--		--
Pyrene	ug/L	NS	< 10	NS	< 10	11000	11000	ug/L	No Violation
1,2,4,-trichlorobenzene	ug/L	NS	< 10	NS	< 10	--	--		--
Polycyclic Aromatic Hydrocarbons (PAHs). Total of: Acenaphthylene; Benzo(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Benzo(ghi)perylene; Benzo(k)fluoranthene; Chrysene; Dibenzo(a,h)anthracene; Indeno(1,2,3-cd)pyrene; and Phenanthrene						0.0310	0.0310	ug/L	
						--	--		

7. GC/ECD Fraction - Pesticides									
Aldrin	ug/L	NS	< 0.01	NS	< 0.01	1.3	1.3	ug/L	No Violation
alpha-BHC	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
beta-BHC	ug/L	NS	< 0.02	NS	< 0.02	**0.0460**	**0.0460**	ug/L	No Violation
gamma-BHC	ug/L	NS		NS		--	--		--
delta-BHC	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
Chlordane	ug/L	NS	< 0.05	NS	< 0.05	0.0040	0.0040	ug/L	Class II and III Violation
4,4[prime]-DDT	ug/L	NS	< 0.01	NS	< 0.01	0.0010	0.0010	ug/L	Class II and III Violation
4,4[prime]-DDE	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
4,4[prime]-DDD	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
Dieldrin	ug/L	NS	< 0.01	NS	< 0.01	0.0019	0.0019	ug/L	Class II and III Violation
alpha-Endosulfan	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
beta-Endosulfan	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
Endosulfan Sulfate	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
Endrin	ug/L	NS	< 0.01	NS	< 0.01	0.0023	0.0023	ug/L	Class II and III Violation
Endrin Aldehyde	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
Heptachlor	ug/L	NS	< 0.01	NS	< 0.01	0.0036	0.0036	ug/L	Class II and III Violation
Heptachlor Epoxide	ug/L	NS	< 0.01	NS	< 0.01	--	--		--
PCB-1242	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
PCB-1254	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
PCB-1221	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
PCB-1232	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
PCB-1248	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
PCB-1260	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
PCB-1016	ug/L	NS	< 0.20	NS	< 0.20	--	--		--
Toxaphene	ug/L	NS	< 0.50	NS	< 0.50	0.0002	0.0002	ug/L	Class II and III Violation

Detection limit higher than standard