



# Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task B.16

## B-HS5 PNRS Effluent Testing for FDOH Additives Rule

June 2014

442-57-001

**HAZEN AND SAWYER**  
Environmental Engineers & Scientists

In association with:



**AET**  
Applied Environmental Technology

**Otis Environmental  
Consultants, LLC**

# **Florida Onsite Sewage Nitrogen Reduction Strategies Study**

## **TASK B.16**

### **B-HS5 PNRS Effluent Testing for FDOH Additives Rule**

#### **Prepared for:**

Florida Department of Health  
Division of Disease Control and Health Protection  
Bureau of Environmental Health  
Onsite Sewage Programs  
4042 Bald Cypress Way Bin #A-08  
Tallahassee, FL 32399-1713

FDOH Contract CORCL

**June 2014**

#### **Prepared by:**

**HAZEN AND SAWYER**  
Environmental Engineers & Scientists

In Association With:

**AET**  
Applied Environmental Technology





## **B-HS5 PNRS Effluent Testing for FDOH Additives Rule**

---

### **Executive Summary**

Effluent sampling and analyses were performed on the B-HS5 full-scale PNRS to evaluate the impact of expanded clay, elemental sulfur and lignocellulosic (a blended urban waste wood from Mother's Organics, Inc., Thonotosassa, FL) media used in the system on effluent quality. Testing was done according to Florida's Additive Rule for Septic System Products established by the Florida Department of Health (FDOH). Each of these media were used in biofilters that enhance nitrogen removal in onsite wastewater treatment systems. Expanded clay is a porous media for aerobic biofilters, while elemental sulfur and lignocellulosic materials are intended as reactive media in anoxic denitrifying biofilters.

Additives testing was conducted by performing chemical analyses and acute toxicity bioassays on effluent samples from the primary tank and Stage 2 biofilter that was actively operating at the passive nitrogen reduction system at home site B-HS5 in Seminole County, Florida. Volatile organic compound (VOC) analyses were conducted using E.P.A. Methods 8260 and 504.1, and acute toxicity testing was performed by ninety-six hour bioassay with *Cyprinella leedsi* (Bannerfin Shiner) according to the E.P.A. Whole Effluent Toxicity (WET) protocol.

The concentrations of VOCs in both effluents were below Method Detection Limits for the majority of chemicals. None of the analytical results exceeded the Guidance Maximum Contaminant Level (GMCL) for VOCs established by the Florida Department of Health.

The primary tank (septic tank effluent) did exhibit toxicity by the WET protocol, with a Lethal Concentration 50 (LC50) of 35.4%. The Stage 2 biofilter effluent did not exhibit toxicity by the WET protocol, as exhibited by LC50 of >100%. The Stage 2 effluent included contact with the following test media: expanded clay, lignocellulosic and elemental sulfur.

o:\44237-001R004\Wpdocs\Report\Final

## 1.0 Background

### 1.1 Florida's Additive Rule for Septic System Products

Florida Department of Health has established specific testing and evaluation requirements for materials that are added to onsite wastewater systems in Florida (FDOH, 2013). Chapter 381.0065 (4) (m), Florida Statutes states: "No product sold in the state for use in onsite sewage treatment and disposal systems may contain any substance in concentrations or amounts that would interfere with or prevent the successful operation of such system, or that would cause discharges from such system to violate applicable water quality standards." The additives rule testing requirements generally include evaluation of volatile organic chemicals by U.S. E.P.A. Method 8260 and acute toxicity bioassay testing by the E.P.A. Whole Effluent Toxicity 96 hr. bioassay protocol (FDOH, 2013).

### 1.2 Media Evaluated

The B-HS5 system evaluated included three media in the treatment train: expanded clay, lignocellulosic material and elemental sulfur.

**Expanded clay (Riverlite)** is taken from a clay deposit, and calcining the clay at a temperature of approximately 2000°F in rotary kilns produces a structural grade lightweight aggregate used for concrete masonry (Big River, 2012). Riverlite has a unit weight of 48 lb/ft<sup>3</sup> (Big River, 2012). Expanded clay is an excellent candidate for onsite wastewater treatment biofilters; they provide an excellent attachment surface for nitrifying microorganisms, significant sorption potential for ammonium ions and a high water retention. A number of studies have addressed the use of expanded clay for water, wastewater and stormwater treatment in various process configurations (Anderson et. al., 1998; Kietlinska and Renman 2005; Hinkle, Böhlke et al. 2008, Smith, 2006; Smith, 2011). Recent FDOH studies have also shown expanded clay to be highly effective as an unsaturated biofilter media for onsite wastewater treatment (Smith, 2009).

**Lignocellulosic** material is a structural component of woody plants and one of the most abundant biopolymers on earth. It is primarily composed of cellulose, hemicellulose and lignin. Cellulose is an organic compound with molecular formula (C<sub>6</sub>H<sub>10</sub>O<sub>5</sub>)<sub>n</sub>, a polysaccharide consisting of a linear chain of several hundred to over ten thousand β(1→4) linked D-glucose units. Hemicellulose is a polysaccharide related to cellulose that comprises ca. 20% of the biomass of most plants. Hemicellulose, in contrast to cellulose, is derived from several sugars in addition to glucose, especially xylose. Lignin is a complex chemical and an integral part of the secondary cell walls of woody plants (Lebo et al., 2001). Lignin is



one of the most abundant organic polymers on Earth, exceeded only by cellulose, and constitutes from a quarter to a third of the dry mass of wood. As a biopolymer, lignin is unusual because of its heterogeneity and lack of a defined primary structure. Lignin is a cross-linked macromolecule composed of three types of substituted phenols (phenylpropanes) having guaiacyl, syringyl p-hydroxyphenyl and biphenyl nuclei, linked and polymerized through a variety of nonhydroxyl stable C-C and C-O-C bonds (Paul, and Clark, 1989). Its structure is based on the phenyl propanoid unit, which consists of an aromatic ring and 3-C side chain. Lignin fills the spaces in the cell wall between cellulose, hemicellulose, and pectin and is covalently linked to hemicellulose; it resembles a kind of phenol-formaldehyde resin that acts like glue to hold the lignocellulose matrix together. The most commonly noted lignin function is the support through strengthening of wood (xylem cells) in trees (Wardrop, 1969). Lignin is generally associated with reduced digestibility of the overall plant biomass, which helps defend against pathogens and pests. As part of natural cycling, lignin degradation is facilitated by microorganisms including fungi and bacteria although the details of biodegradation are not well understood. Organic products of lignin degradation can be further processed by bacteria.

Southern Yellow Pine (SYP) is a collective term that refers to a group of coniferous species which are classified as yellow pine (as opposed to white pine) and which are native to the Southern United States. Pines are a common feature of the Florida landscape. There are seven species of pines that are native to Florida and three other commonly planted non-native species (Amy and Flinchum, (2011). They grow very well in the acidic soil found in the region. The varieties principally include Longleaf (*Pinus palustris*), Loblolly (*Pinus taeda*), Shortleaf (*Pinus echinata*), and Slash (*Pinus elliotti*) pine (Forest Products Laboratory, 1936). There are generally no fundamental differences among southern pines for lumber production and Longleaf and Slash pines have historically been responsible for 60% of the world's turpentine supply.

The use of lignocellulosic material has been generally recognized as a viable approach to engineered denitrification (Schipper et al., 2010a; Collins et al., 2010). Successful application of lignocellulosic materials as electron donor in passive denitrification systems has been reported in many studies (Cameron and Schipper, 2010; Elgood et al., 2010; Moorman et al., 2010; Oakley et al. 2010; Schipper et al., 2010b; Woli et al., 2010). Several studies have successfully applied pine based lignocellulosics in denitrification biofilters (Cameron and Schipper, 2010; Elgood et al., 2010; Robertson, 2010; Schipper et al., 2010c).

**Elemental sulfur** is a non-metallic element on the periodic chart, with an atomic number of 16 and atomic weight of 32.065. It is known as Brimstone in its natural state. It is insoluble in water, tasteless and odorless, and often occurs as a light yellow solid. Sulfur is distributed widely over the earth's surface and occurs in both combined and free states. A significant amount of the world's supply of sulfur for human uses formerly came from sulfur-bearing limestone deposits found in the Gulf Coast region of North America.

Currently, elemental sulfur is produced primarily through its recovery from the hydrogen sulfide (H<sub>2</sub>S) in "sour" natural gas and by refining of petroleum (Claus process).

The rhombic structure is the most commonly found sulfur form and consists of eight sulfur atoms (S<sub>8</sub>) arranged in a puckered-ring structure. Rhombic elemental sulfur has a molecular weight of 256.50 Da, a specific gravity of 2.07 at 70°F. The rhombic structure is the stable crystalline form at one atmosphere pressure and temperature less than 95.4°C, while the monoclinic crystalline structure is thermodynamically dominant from 95.4°C up to the melt temperature of 118.9°C. Elemental sulfur is not readily wetted or dissolved by water.

Numerous studies have addressed the use of elemental sulfur for denitrification in laboratory and field studies in a variety of biofilter configurations (Aoi et al., (2005); Batchelor et al., 1978; Bisogni et al., 1977; Darbi et al., 2003b; Darbi et al., 2002; Darbi et al., 2003a; Flere and Zhang, 1998; Furumai et al., 1996; Hasegawa and Hanaki, 2001; Hwang et al., 2005; Kanter et al., 1998; Kim et al., 2004; Kim and Bae, 2000; Kim et al., 2003; Koenig and Liu, 2002; Koenig and Liu, 2004; Koenig et al., 2005; Kuai and Verstraete, 1999; Lampe and Zhang, 1996; Li et al., 2009; Moon et al., 2004; Moon et al., 2006; Moon et al., 2008; Nugroho et al., 2002; Oh et al., 2002; Oh et al., 2001; Park et al., 2002; Shan and Zhang, 1998; Sierra-Alvarez et al., 2007; Soares, 2002; Tanaka et al., 2007; Wang et al., 2005; Yamamoto-Ikemoto and Komori, 2003; Zeng and Zhang, 2005; Zhang, 2002; Zhang, 2004; Zhang and Lampe, 1999; Zhang and Shan, 1999). Recently, elemental sulfur was shown to be highly effective in supporting onsite wastewater denitrification in saturated anoxic biofilters (Smith, 2009).

### 1.3 Known and Expected Reactions

Expanded clay serves as a support media for microorganisms that catalyze many types of biochemical reactions without necessarily participating directly in them. Lignocellulosic media is expected to degrade through hydrolytic reactions which may be enhanced by microbial processes, thereby releasing organic carbon which may undergo possible subsequent reactions to produce labile organic carbon compounds that can be used by heterotrophic denitrifying microorganisms. Elemental sulfur is expected to undergo oxidative dissolution catalyzed

by autotrophic microbial processes when external electron donors are present, including molecular oxygen, nitrate, and nitrite.

## **2.0 Testing Methods**

### **2.1 Source of Media**

Expanded clay was purchased from Big River Industries, Inc., Irwinville, LA in Riverlite G 1/4 and 3/16 size gradations, which were used directly in the biofilters. The expanded clay has a bulk density of approximately 48 lbs/ft<sup>3</sup>. A Material Safety Data Sheet (MSDS) for Riverlite is included in Appendix A. Lignocellulosic material was procured in June 2013 from an organic waste composting facility Mother's Organics, Inc. Thonotosassa, FL. The material was a hardwood mulch from the internal sections of wood waste and did not include bark, small limbs, and leaf components. A Material Safety Data Sheet (MSDS) for lignocellulosic material is included in Appendix B. Pastille elemental sulfur was supplied by CoreAgri, Arroya Grande, CA. The ES99 material has a bulk density of 76 lbs/ft<sup>3</sup> and a minimum elemental sulfur content of 99.5%. The MSDS for ES99 pastille sulfur is included in Appendix C.

### **2.2 Biofilter Configuration and Sample Collection**

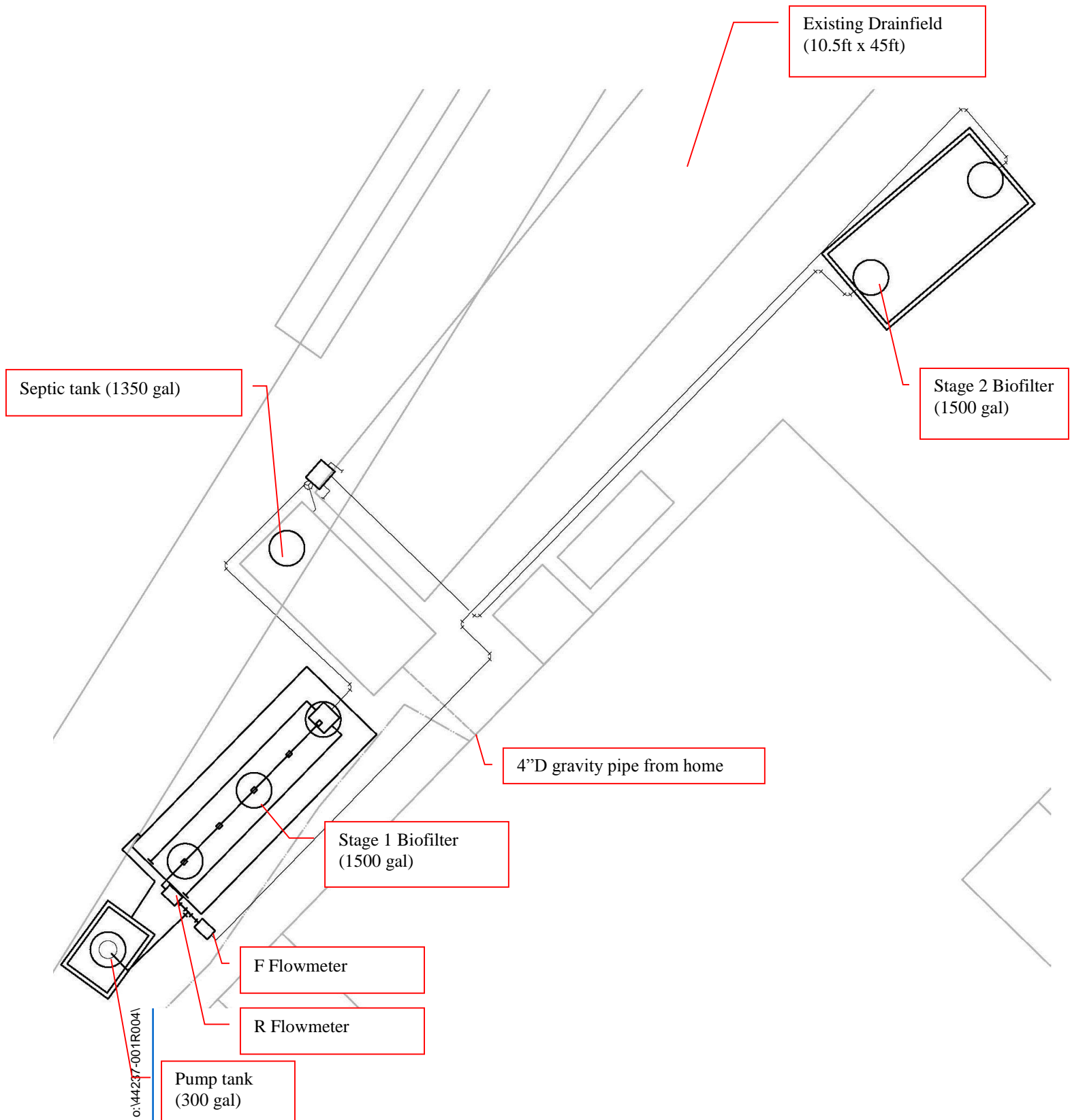
The nitrogen reducing onsite treatment system for the single family residence was installed in June 2013. Design and construction details were presented previously in the Task B.6 document. Figure 1 is a system schematic showing the system components and layout of the installation. The PNRS system consists of a 1,350 gallon single chamber concrete primary tank; 1,500 gallon plastic tank Stage 1 unsaturated media filter; and 1,500 gallon two chamber concrete Stage 2 saturated media biofilter. The treated effluent is discharged into the soil via the existing drainfield (a standard bed).

The PNRS system had been operating for approximately forty-six weeks when samples were collected for additives testing. A sample of septic tank effluent (STE) was collected for chemical analysis. Household wastewater enters the primary tank and exits as septic tank effluent through an effluent filter screen into the Stage 1 biofilter. The effluent was sampled approximately 1.5 feet below the surface of the primary tank prior to the effluent filter which is referred to as primary effluent or STE. Samples are representative of the whole household wastewater and represent the influent to the remainder of the onsite nitrogen reduction system. The Stage 2 biofilter effluent was collected from the second chamber of the Stage 2 biofilter sampled approximately 1 foot below the surface of the



effluent baffle tee. This sample location is after passage through the expanded clay media within the Stage 1 biofilter, lignocellulosic media in the first chamber of the Stage 2 biofilter, and the sulfur media in the second chamber of the Stage 2 biofilter. It is the final effluent from the treatment system prior to being discharged to the soil infiltration system, or drainfield.

Biofilter characteristics are listed in Table 1. Samples were collected into specific sample containers for chemical and bioassay analysis, immediately placed in coolers on ice, and transported to laboratories in Oldsmar and Sarasota, FL. As a part of the Passive Nitrogen Removal Study, a water quality monitoring event was conducted on May 28, 2014. The water quality data (Table 2) represent conditions when the bioassay samples were collected and can be used to provide insight into biofilter performance when the effluent samples were collected for the Additives Testing.



**Figure 1**  
**Plan view of B-HS5 System Layout**

**Table 1**  
**Passive Nitrogen Reduction System Components**

	Influent	Tank Volume (gal)	Surface Area (ft <sup>2</sup> )	Media	Media Saturated or Unsaturated
Primary Tank	Wastewater from home	1,350	55	none	N/A
Stage 1 Biofilter	Primary tank effluent	1,500	78	12" Riverlite 1/4 21" Riverlite 3/16	Unsaturated
Pump tank	Stage 1 effluent	300	12	none	N/A
Stage 2a Biofilter, downflow	Stage 1 effluent	1,000 (1,500 total)	36 (54 total)	42" lignocellulosic	Saturated
Stage 2b Biofilter, upflow	Stage 2a effluent	500 (1,500 total)	18 (54 total)	18" Elemental sulfur (90%) & oyster shell mixture (10%)	Saturated



**Table 2**  
**Biofilter Effluent Water Quality May 28, 2014**

Parameter	Primary tank (STE)	Stage 2 effluent
Temperature, °C	26.4	25.2
Dissolved oxygen, mg/L	0.05	0.08
Oxidation Reduction Potential, mV	-235	-209
Specific conductance, umhos/cm	1254	1249
pH	7.09	6.41
Total alkalinity, mg/L as CaCO <sub>3</sub>	410	370
Total suspended solids, mg/L	34	4
Volatile suspended solids, mg/L	31	4
Carbonaceous five day biochemical oxygen demand, mg/L	74	13
Chemical oxygen demand, mg/L	180	27
Total nitrogen, mg/L	61	1.3
Total kjeldahl nitrogen, mg/L	61	1.3
Ammonia nitrogen, mg/L <sup>1</sup>	0.3 <sup>1</sup>	21 <sup>1</sup>
Nitrate nitrogen, mg/L	0.01	0.01
Nitrite nitrogen, mg/L	0.01	0.01
Sulfate, mg/L	9.6	160
Sulfide, mg/L	9.7	7.7
Hydrogen sulfide, unionized, mg/L	4.6	6.3
Total phosphorus, mg/L	5.3	0.89
Orthophosphate phosphorus, mg/L	5.1	0.38
Total organic carbon, mg/L	51	13
Fecal coliform, Ct/100 mL	49,000	1
e-coli, Ct/100 mL	24,000	2

<sup>1</sup>Ammonia N value is likely an analytical error and has been requested to be re-run by the laboratory.

## 2.3 Chemical Analyses

Chemical analyses were conducted by Southern Analytical Laboratories Inc., 110 Bayview Boulevard, Oldsmar, Florida. Southern Analytical Laboratory, Inc. is NELAP accredited through the Florida Department of Health. Florida's Additive Rule for Septic System Products specifies that E.P.A. Method 8260 be used to analyze for volatile organic chemicals.

The organic chemicals quantified by Method 8260 are listed in Table 3 along with Guidance Maximum Contaminant Levels (MCLs) established by FDOH and Method Detection Limits (MDLs). E.P.A. Method 504.1 was additionally employed to achieve lower MDLs for the two

chemicals listed in Table 4. Analytical MDLs were less than the FDOH Guidance Maximum Contaminant Levels (MCLs) for all chemicals.

**Table 3**  
**Guidance MCLs and Method Detection Limits for E.P.A. 8260 Parameters**

#	Chemical Parameter (EPA 8260)	CAS #	FDOH VOC Guidance MCL, ug/L <sup>1</sup>	MDL, ug/L
1	1,1,1,2-Tetrachloroethane	630-20-6	1	0.5
2	1,1,1-Trichloroethane	71-55-6	200	0.5
3	1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.18
4	1,1,2-Trichloroethane	79-00-5	5	0.5
5	1,1-Dichloroethane	75-34-3	700	0.5
6	1,1-Dichloroethene (Vinylidene Chloride)	75-35-4	7	0.5
7	1,1-Dichloropropene	563-58-6	1	0.5
8	1,2,3-Trichlorobenzene	87-61-6	70	0.5
9	1,2,3-Trichloropropane	96-18-4	42	0.36
10	1,2,4-Trichlorobenzene	120-82-1	70	0.5
11	1,2,4-Trimethylbenzene	95-63-6	10	0.5
12	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2	0.3
13	1,2-Dibromoethane (EDB, Ethylene dibromide)	106-93-4	0.02	0.2
14	1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	600	0.5
15	1,2-Dichloroethane (Ethylene dichloride)	107-06-2	3	0.5
16	1,2-Dichloropropane	78-87-5	5	0.5
17	1,3,5-Trimethylbenzene	108-67-8	10	0.5
18	1,3-Dichlorobenzene (m-Dichlorobenzene)	541-73-1	10	0.5
19	1,4-Dichlorobenzene (p-Dichlorobenzene)	106-46-7	75	0.5
20	2,2-Dichloropropane	594-20-7	5	0.5
21	2-Butanone (Methyl ethyl ketone) (MEK)	78-93-3	4200	5
22	2-Chloroethyl Vinyl Ether	110-75-8	1	0.5
23	o-Chlorotoluene	95-49-8	140	0.5
24	Hexachlorobutadiene	87-68-3	0.5	0.5
25	p-Chlorotoluene	106-43-4	140	0.5
26	4-Isopropyltoluene (p-Cymene)	99-87-6	70	0.5
27	4-Methyl-2-pentanone (Methyl isobutyl ketone) [MIBK]	108-10-1	350	5
28	Acetone	67-64-1	700	5
29	Benzene	71-43-2	1	0.5
30	Bromobenzene	108-86-1		0.5
31	Bromochloromethane	74-97-5	91	0.5
32	Bromodichloromethane	75-27-4	0.6	0.27
33	Bromoform	75-25-2	4	0.5
34	Bromomethane (Methyl bromide)	74-83-9	9.8	0.5
35	Carbon disulfide	75-15-0	700	0.5
36	Carbon Tetrachloride (Tetrachloromethane)	56-23-5	3	0.5
37	Chlorobenzene	108-90-7	100	0.5
38	Chloroethane (Ethyl chloride)	75-00-3	12	0.5
39	Chloroform	67-66-3	70	0.5
40	Chloromethane (Methyl chloride)	74-87-3	2.7	0.62

p:\44237-001\R004\Wpdocs\Report\Final

**Table 3 (con't)**  
**Guidance MCLs and Method Detection Limits for E.P.A. 8260 Parameters**

#	Chemical Parameter (EPA 8260)	CAS #	FDOH VOC Guidance MCL, ug/L <sup>1</sup>	MDL, ug/L
41	cis-1,2-Dichloroethene	156-59-2	70	0.5
42	cis-1,3-Dichloropropene (DCP, Telone)	10061-02-5	1	0.25
43	Dibromochloromethane	124-48-1	0.4	0.26
44	Dibromomethane	74-95-3		0.5
45	Dichlorodifluoromethane (CFC 12)	75-71-8	1400	0.5
46	Ethylbenzene	100-41-4	30	0.5
47	Isopropylbenzene (Cumene)	98-82-8	0.8	0.5
48	m,p-Xylenes	1330-20-7	20	0.5
49	Methylene Chloride (Dichloromethane)	75-09-2	5	2.5
50	Methyl-tert-Butyl-Ether (MTBE)	1634-04-4	20	0.5
51	Naphthalene	91-20-3	14	0.5
52	n-Butyl Benzene	104-51-8	280	0.5
53	n-Propyl Benzene	103-65-1	280	0.5
54	o-Xylene	95-47-6	20	0.5
55	sec-Butylbenzene	135-98-8	280	0.5
56	Styrene (Vinyl benzene)	100-42-5	100	0.5
57	tert-Butylbenzene	98-06-6	280	0.5
58	Tetrachloroethene	127-18-4	3	0.5
59	Toluene	108-88-3	40	0.5
60	trans-1,2-Dichloroethene	156-60-5	100	0.5
61	trans-1,3-Dichloropropene	10061-01-5	0.4	0.25
62	Trichloroethene (TCE)	79-01-6	3	0.5
63	Trichlorofluoromethane (CFC 11)	75-69-4	2100	0.5
64	Vinyl chloride	75-01-4	1	0.5
65	Xylenes (Total)	1330-20-07	20	0.5
66	2-Hexanone	591-78-6		2.1
67	Acrylonitrile	107-13-1		1.3
68	Iodomethane	74-88-4		0.2
69	trans-1,4-Dichloro-2-butene	110-57-6		0.3
70	Vinyl acetate	108-05-4		0.4

<sup>1</sup>Provided by Sonia Cruz, FDOH

**Table 4**  
**Guidance MCLs and Method Detection Limits for E.P.A. 504.1 Parameters**

#	Chemical Parameter (EPA 504.1)	CAS #	FDOH VOC Guidance MCL, ug/L <sup>1</sup>	MDL, ug/L
71	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2	0.0048 - 0.0050
72	1,2-Dibromoethane (EDB, Ethylene dibromide)	106-93-4	0.02	0.0061 - 0.0063

<sup>1</sup>Provided by Sonia Cruz, FDOH

o:\44237-001R004\Wpdocs\Report\Final



## 2.4 Acute Toxicity Bioassays

Acute toxicity bioassays were conducted by Marinco Bioassay Laboratory, Inc., 4569 Samuel Street, Sarasota, Florida. Marinco Bioassay Laboratory, Inc. is NELAP accredited through the Florida Department of Health. The bioassay tests followed standard protocols for whole effluent toxicity testing (U.S. Environmental Protection Agency, 2002). Ten day old *Cyprinella leedsi* (Bannerfin Shiner) were the sensitive test organisms used in the bioassays (Figure 2).



**Figure 2**  
***Cyprinella leedsi***

## 3.0 Results and Discussion

### 3.1 Chemical Analyses

The concentrations of VOCs in both effluents are shown in Table 5. VOCs were below Method Detection Limits for the majority of chemicals. A full laboratory report of VOC analytical results is included in Appendix D. The reported VOC analytical results reported for both effluents show that none exceeded the Guidance Maximum Contaminant Level (GMCL) for VOCs established by the Florida Department of Health.

**Table 5**  
**Effluent Analyte Concentrations and FDOH Guidance Levels**

#	Chemical Parameter	CAS #	FDOH Guid- ance MCL, ug/L	Effluent Concentration (ug/L) <sup>1,2</sup>	
				Pri- mary Tank (STE)	Stage 2 effluent
1	1,1,1,2-Tetrachloroethane	630-20-6	1	0.2	0.2
2	1,1,1-Trichloroethane	71-55-6	200	0.2	0.2
3	1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.2	0.2
4	1,1,2-Trichloroethane	79-00-5	5	0.2	0.2
5	1,1-Dichloroethane	75-34-3	700	0.2	0.2
6	1,1-Dichloroethene (Vinylidene Chloride)	75-35-4	7	0.2	0.2
7	1,1-Dichloropropene	563-58-6	1	0.2	0.2
8	1,2,3-Trichlorobenzene	87-61-6	70	0.2	0.2
9	1,2,3-Trichloropropane	96-18-4	42	0.4	0.4
10	1,2,4-Trichlorobenzene	120-82-1	70	0.3	0.3
11	1,2,4-Trimethylbenzene	95-63-6	10	0.1	0.1
12	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2	0.3	0.3
13	1,2-Dibromoethane (EDB, Ethylene dibromide)	106-93-4	0.02	0.2	0.2
14	1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	600	0.1	0.1
15	1,2-Dichloroethane (Ethylene dichloride)	107-06-2	3	0.1	0.1
16	1,2-Dichloropropane	78-87-5	5	0.2	0.2
17	1,3,5-Trimethylbenzene	108-67-8	10	0.1	0.1
18	1,3-Dichlorobenzene (m-Dichlorobenzene)	541-73-1	10	0.07	0.07
19	1,4-Dichlorobenzene (p-Dichlorobenzene)	106-46-7	75	0.2	0.2
20	2,2-Dichloropropane	594-20-7	5	0.3	0.3
21	2-Butanone (Methyl ethyl ketone) (MEK)	78-93-3	4200	2.2	2
22	2-Chloroethyl Vinyl Ether	110-75-8	1	0.5	0.5
23	o-Chlorotoluene	95-49-8	140	0.1	0.1
24	Hexachlorobutadiene	87-68-3	0.5	0.4	0.4
25	p-Chlorotoluene	106-43-4	140	0.1	0.1
26	4-Isopropyltoluene (p-Cymene)	99-87-6	70	0.3	0.2
27	4-Methyl-2-pentanone (Methyl isobutyl ketone) [MIBK]	108-10-1	350	2.6	2.6
28	Acetone	67-64-1	700	100	2
29	Benzene	71-43-2	1	0.1	0.1
30	Bromobenzene	108-86-1		0.2	0.2
31	Bromochloromethane	74-97-5	91	0.1	0.1
32	Bromodichloromethane	75-27-4	0.6	0.2	0.2
33	Bromoform	75-25-2	4	0.2	0.2
34	Bromomethane ( Methyl bromide)	74-83-9	9.8	0.4	0.4
35	Carbon disulfide	75-15-0	700	0.5	0.5
36	Carbon Tetrachloride (Tetrachloromethane)	56-23-5	3	0.2	0.2
37	Chlorobenzene	108-90-7	100	0.1	0.1
38	Chloroethane (Ethyl chloride)	75-00-3	12	0.4	0.4
39	Chloroform	67-66-3	70	0.2	0.2
40	Chloromethane (Methyl chloride)	74-87-3	2.7	0.4	0.4

o:\44237-001R004\Wpdocs\Report\Final

#	Chemical Parameter	CAS #	FDOH Guidance MCL, ug/L	Effluent Concentration (ug/L) <sup>1,2</sup>	
				Primary Tank (STE)	Stage 2 effluent
41	cis-1,2-Dichloroethene	156-59-2	70	0.09	0.09
42	cis-1,3-Dichloropropene (DCP, Telone)	10061-02-5	1	0.2	0.2
43	Dibromochloromethane	124-48-1	0.4	0.1	0.1
44	Dibromomethane	74-95-3		0.2	0.2
45	Dichlorodifluoromethane (CFC 12)	75-71-8	1400	0.5	0.5
46	Ethylbenzene	100-41-4	30	0.08	0.08
47	Isopropylbenzene (Cumene)	98-82-8	0.8	0.1	0.1
48	m,p-Xylenes	1330-20-7	20	0.2	0.2
49	Methylene Chloride (Dichloromethane)	75-09-2	5	0.2	0.2
50	Methyl-tert-Butyl-Ether (MTBE)	1634-04-4	20	0.2	0.2
51	Naphthalene	91-20-3	14	0.2	0.2
52	n-Butyl Benzene	104-51-8	280	0.2	0.2
53	n-Propyl Benzene	103-65-1	280	0.1	0.1
54	o-Xylene	95-47-6	20	0.2	0.2
55	sec-Butylbenzene	135-98-8	280	0.2	0.2
56	Styrene (Vinyl benzene)	100-42-5	100	0.05	0.05
57	tert-Butylbenzene	98-06-6	280	0.1	0.1
58	Tetrachloroethene	127-18-4	3	0.1	0.1
59	Toluene	108-88-3	40	0.5	0.09
60	trans-1,2-Dichloroethene	156-60-5	100	0.2	0.2
61	trans-1,3-Dichloropropene	10061-01-5	0.4	0.1	0.1
62	Trichloroethene (TCE)	79-01-6	3	0.2	0.2
63	Trichlorofluoromethane (CFC 11)	75-69-4	2100	0.2	0.2
64	Vinyl chloride	75-01-4	1	0.3	0.3
65	Xylenes (Total)	1330-20-07	20	0.1	0.1
66	2-Hexanone	591-78-6		2.1	2.1
67	Acrylonitrile	107-13-1		1.3	1.3
68	Iodomethane	74-88-4		0.2	0.2
69	trans-1,4-Dichloro-2-butene	110-57-6		0.3	0.3
70	Vinyl acetate	108-05-4		0.4	0.4
<b>E.P.A. 504.1 Parameters</b>					
71	1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2	0.0054	0.0055
72	1,2-Dibromoethane (EDB, Ethylene dibromide)	106-93-4	0.02	0.0054	0.0055

<sup>1</sup>Gray-shaded data points indicate values below method detection level (mdl), mdl value used for statistical analyses.

<sup>2</sup>Yellow-shaded data points indicate the reported value is between the laboratory method detection limit and the laboratory practical quantitation limit, value used for statistical analysis.

### 3.2 Acute Toxicity Bioassays

Results of acute bioassay testing with *Cyprinella leedsii* are summarized in Table 6. A full laboratory report of acute bioassay testing is included in Appendix E. The primary tank (septic tank effluent) did exhibit toxicity by the WET protocol, with a Lethal Concentration



50 (LC50) of 35.4%. The Stage 2 biofilter effluent did not exhibit toxicity by the WET protocol, as exhibited by Lethal Concentration 50 (LC50) of greater than 100%.

**Table 6**  
**Acute Bioassay Results with *Cyprinella leedsi***

Biofilter	Effluent LC 50
BHS5-STE	35.4%
BHS5-ST2	>100%

Whole Effluent Toxicity Test Permit requirement of LC50 > 100%

#### 4.0 Summary

Testing was conducted on the full-scale PNRS at site B-HS5 to evaluate the impact of expanded clay, elemental sulfur and lignocellulosic (a blended urban waste wood from Mother's Organics, Inc., Thonotosassa, FL) media on effluent quality. Testing was done according to *Florida's Additive Rule For Septic System Products* established by the Florida Department of Health (FDOH). Each of these materials were used as a treatment media for biofilters that enhance nitrogen removal in onsite wastewater treatment systems. Expanded clay is a porous media for aerobic biofilters, while elemental sulfur and lignocellulosic materials are intended as reactive media in anoxic denitrifying biofilters. Additives testing was conducted by performing chemical analyses and acute toxicity bioassays on effluent samples from the primary tank and Stage 2 biofilter that was actively operating at the passive nitrogen reduction system at home site B-HS5 in Seminole County, Florida.

Analysis of volatile organic compounds (VOCs) employed E.P.A. Methods 8260 and 504.1. The VOC concentrations were below Method Detection Limits for the majority of chemicals in both effluents. The reported VOC analytical results reported for both effluents show that none exceeded the Guidance Maximum Contaminant Level (GMCL) for VOCs established by the Florida Department of Health.

Acute toxicity testing was performed by ninety-six hour bioassays using *Cyprinella leedsi* (Bannerfin Shiner) according to the E.P.A. Whole Effluent Toxicity (WET) protocol. The primary tank (septic tank effluent) did exhibit toxicity by the WET protocol, with a Lethal Concentration 50 (LC50) of 35.4%. The treatment provided by the PNRS appeared to eliminate the toxicity of the primary effluent, as the Stage 2 effluent did not exhibit toxicity by the WET protocol, as exhibited by Lethal Concentration 50 (LC50) of greater than 100%.

## 5.0 References

- Aoi, Y., Y. Shiramasa, E. Kakimoto, S. Tsuneda, A. Hirate, and T. Nagamune (2005) Single-stage autotrophic nitrogen-removal process using a composite matrix immobilizing nitrifying and sulfur-denitrifying bacteria. *Applied Microbiology and Biotechnology*, 68: 124-130.
- Amy, N. and D. Flinchum (2011). Common Pines of Florida. Institute of Food and Agriculture Science Extension, FOR21, University of Florida, Gainesville, FL. <http://edis.ifas.ufl.edu/pdf/FR/FR00300.pdf>
- Anderson, D. L., M.B. Tyl, R.J. Otis, T.G. Mayer, and K.M. Sherman. 1998. Onsite Wastewater Nutrient Reduction Systems (OWNRS) for Nutrient Sensitive Environments. In: *On-Site Wastewater Treatment*, Vol. 8. D. M. Sievers, Ed. ASAE Publ. 03-98, American Society of Agricultural Engineers, St. Joseph, MI. pp. 436-445.
- Batchelor, B. and Lawrence, A. (1978) Autotrophic denitrification using elemental sulfur. *J. Water Pollut. Control Fed*, 50: 1986-2001.
- Bertrand-Krajewski, J. -L.; Lefebvre, M.; Barker, J. (1997) Ammonia Removal and Discharges During Storm Events: Integrated Approach for a Small WWTP and Associated CSOs. *Water Sci. Technol.*, **36(8-9)**, 229–234.
- Big River Industries (2012) Riverlite® MSDS Sheet, LA Division. <http://www.bigriver-industries.com>.
- Bisogni, J., J.J. and Driscoll, J., C.T. (1977) Denitrification Using Thiosulfate and Sulfide. *Journal of Environmental Engineering*, 103(EE4): 593-604.
- Cameron, S.G., Schipper, L.A. (2010) Nitrate removal and hydraulic performance of organic carbon for use in denitrification beds. *Ecological Engineering* 36, 1588-1595.
- Celik, M.; Ozdemir, B.; Turan, M.; Koyuncu, I.; Atesok, G.; Sarikaya, H. (2001) Removal of Ammonia By Natural Clay Minerals Using Fixed and Fluidised Bed Column Reactors. *Water Sci. Technol.*, **1**, 81–88.
- Collins, K.A., Lawrence, T.J., Stander, E.K., Jontos, R.J., Kaushal, S.S., Newcomer, T.A., Grimm, N.B., Cole Ekberg, M.L. (2010) Opportunities and challenges for managing nitrogen in urban stormwater: A review and synthesis. *Ecological Engineering* 36, 1507-1519.
- Darbi, A., Viraraghavan, T., Butler, R. and Corkal, D. (2002) Batch studies on nitrate removal from potable water. *Water SA*, 28(3).
- Darbi, A., Viraraghavan, T., Butler, R. and Corkal, D. (2003a) Pilot-Scale Evaluation of Select Nitrate Removal Technologies. *Journal of Environmental Science and Health Part A— Toxic/Hazardous Substances & Environmental Engineering*, A38(9): 1703-1715.

- Darbi, A. and Viraraghavan, T. (2003b) A Kinetic Model for Autotrophic Denitrification using Sulphur:Limestone Reactors. *Water Qual. Res. J. Canada*, 38(1): 183-193.
- Elgood, Z., Robertson, W.D., Schiff, S.L., Elgood, R. (2010) Nitrate removal and greenhouse gas in a stream-bed denitrifying bioreactor. *Ecological Engineering* 36, 1575-1580.
- Flere, J. and Zhang, T. (1998) Sulfur-Based Autotrophic Denitrification Pond Systems for In-Situ Remediation of Nitrate-Contaminated Surface Water. *Water Science and Technology*, 38(1): 15-22.
- Florida Department of Health (2013) *Florida's Additive Rule For Septic System Products*. <http://www.doh.state.fl.us/environment/ostds/additives/additives.html>, Florida Department of Health Onsite Sewage Program, Tallahassee, Florida.
- Forest Products Laboratory (1936). Southern Yellow Pine, Technical Note 214, United States Forest Service, Madison, Wisconsin.
- Furumai, H., Tagui, H. and Fujita, K. (1996). Effects of pH and alkalinity on sulfur-denitrification in a biological granular filter. *Water Science and Technology*, 34(1-2): 355-362.
- Haneke, K. (2002) Turpentine (Turpentine Oil, Wood Turpentine, Sulfate Turpentine, Sulfite Turpentine) [8006-64-2] Review of Toxicological Literature. *Prepared for National Institute of Research, Triangle Park, North Carolina 27709, Contract No. N01-ES-65402, February 2002.*
- Hasegawa, K. and Hanaki, K. (2001) Nitrous oxide and nitric oxide emissions during sulfur denitrification in soil-water system. *Advances in Water and Wastewater Treatment Technology. Molecular Technology, Nutrient Removal, Sludge Reduction and Environmental Health.* : 185-196.
- Hazen and Sawyer (2009) Passive Nitrogen Removal Study II Quality Assurance Project Plan Final Report, November 2009, Revised and Amended June 2010, Florida Onsite Sewage Nitrogen Reduction Strategies Study Task A.15, submitted to Florida Department of Health, Tallahassee, Florida.
- Hinkle, S. R., J. K. Böhlke, et al. (2008). "Mass balance and isotope effects during nitrogen transport through septic tank systems with packed-bed (sand) filters." *Science of The Total Environment* **407**(1): 324-332.
- Howard, P. (1991). *Handbook of Environmental Fate and Exposure Data for Organic Chemicals*. CRC Press, Boca Raton, FL.
- Hwang, Y., Kim, C. and Choo, I. (2005) Simultaneous Nitrification/Denitrification in a Single Reactor using Ciliated Columns Packed with Granular Sulfur. *Water Qual Res. J. Canada*, 40(1): 91-96.
- Jenssen, P.D., Krogstad, T., Paruch, A.M., Mæhlum, T., Adam, K., Arias, C.A., Heistad, A., Jonsson, L., Hellström, D., Brix, H., Yli-Halla, M., Vråle, L., Valve,

- M. (2010) Filter bed systems treating domestic wastewater in the Nordic countries - Performance and reuse of filter media. *Ecological Engineering* 36, 1651-1659.
- Kanter, R.D., Tyler, E.J. and Converse, J.C. (1998). A denitrification system for domestic wastewater using sulfur oxidizing bacteria. In: D.M. Sievers (Editor), *On-Site Wastewater Treatment - Eighth National Symposium on Individual and Small Community Sewage Systems*. American Society of Agricultural Engineers, Orlando, Florida, pp. 509-519.
- Kellogg, D.Q., Gold, A.J., Cox, S., Addy, K., August, P.V. (2010) A geospatial approach for assessing denitrification sinks within lower-order catchments. *Ecological Engineering* 36, 1596-1606.
- Kietlinska, A. and G. Renman (2005). "An evaluation of reactive filter media for treating landfill leachate." *Chemosphere* 61(7): 933-940.
- Kim, C., Jung, H., Kim, K. and Kim, I. (2004) Treatment of High Nitrate-Containing Wastewaters by Sequential Heterotrophic and Autotrophic Denitrification. *Journal of Environmental Engineering*, 130(12): 1475-1480.
- Kim, E. and Bae, J. (2000) Alkalinity requirements and the possibility of simultaneous heterotrophic denitrification during sulfur-utilizing autotrophic denitrification. *Water Sci. Technol*, 42(3-4): 233-238.
- Kim, J., Hwang, Y., Kim, C. and Bae, J. (2003) Nitrification and denitrification using a single biofilter packed with granular sulfur. *Water Science and Technology*, 47(11): 153-156.
- Koenig, A. and Liu, L. (2002) Use of limestone for pH control in autotrophic denitrification: continuous flow experiments in pilot-scale packed bed reactors. *Journal of Biotechnology*, 99(10/267630): 161-171.
- Koenig, A. and Liu, L. (2004) Autotrophic Denitrification of High-Salinity Wastewater Using Elemental Sulfur: Batch Tests. *Water Environment Research*, 76(1): 37-46.
- Koenig, A., Zhang, T., Liu, L. and Fang, H. (2005) Microbial community and biochemistry process in autosulfurotrophic denitrifying biofilm. *Chemosphere*, 58: 1041-1047.
- Kuai, L. and Verstraete, W. (1999) Autotrophic denitrification with elemental sulphur in small-scale wastewater treatment facilities. *Environmental Technology* 20(2): 201-209.
- Lampe, D. and Zhang, T. (1996) Evaluation of nitrogen removal systems for on-site sewage disposal, *Proceedings of the 1996 HSRC/WERC Joint Conference on the Environment*, Albuquerque, NM.
- Lebo, Stuart E. Jr.; Gargulak, Jerry D. and McNally, Timothy J. (2001). Lignin. *Kirk Othmer Encyclopedia of Chemical Technology*. John Wiley & Sons, Inc.

- Li, W., Zhao, Q.-I. and Liu, H. (2009) Sulfide removal by simultaneous autotrophic and heterotrophic desulfurization-denitrification process. *Journal of Hazardous Materials*, 162(23): 848-853.
- Madhyastha, K. and P. Bhattacharyya (1968) Microbiological transformations of terpenes. 13. Pathways for degradation of p-cymene in a soil pseudomonad (PL-strain). *Indian J Biochem.* 5, 4, 161-167.
- Madhyastha, K., P. Rangachari, R. Raghavendra, and P. Bhattacharyya (1968) Microbial transformation of terpenes. XV. Enzyme systems in the catabolism of p-cymene in PL-strain. *Indian J Biochem.* 5, 4, 167-173.
- Moon, H.S., Ahn, K.H., Lee, S., Nam, K. and Kim, J.Y. (2004) Use of autotrophic sulfur-oxidizers to remove nitrate from bank filtrate in a permeable reactive barrier system. *Environmental Pollution*, 129(3): 499-507.
- Moon, H.S., Chang, S.W., Nam, K., Choe, J. and Kim, J.Y. (2006) Effect of reactive media composition and co-contaminants on sulfur-based autotrophic denitrification. *Environmental Pollution*, 144(3): 802-807.
- Moon, H.S., Shin, D.Y., Nam, K. and Kim, J.Y. (2008) A long-term performance test on an autotrophic denitrification column for application as a permeable reactive barrier. *Chemosphere*, 73(5): 723-728.
- Moorman, T.B., Parkin, T.B., Kaspar, T.C., Jaynes, D.B. (2010) Denitrification activity, wood loss, and N<sub>2</sub>O emissions over 9 years from a wood chip bioreactor. *Ecological Engineering* 36, 1567-1574.
- Nakhla, G.; Farooq, S. (2003) Simultaneous Nitrification-Denitrification in Slow Sand Filters. *J. Hazard. Mater.*, **96**, 291–303.
- Nugroho, R., Takanashi, H., Hirata, M. and Hano, T. (2002) Denitrification of industrial wastewater with sulfur and limestone packed column. *Water Science and Technology*, 46(11-12): 99-104.
- Oakley, S.M., Gold, A.J., Oczkowski, A.J. (2010) Nitrogen control through decentralized wastewater treatment: Process performance and alternative management strategies. *Ecological Engineering* 36, 1520-1531.
- Oh, S., Burn, M., Yoo, Y., Zubair, A. and Kim, I. (2002) Nitrate removal by simultaneous sulfur utilizing autotrophic and heterotrophic denitrification under different organics and alkalinity conditions: batch experiments. *Water Science and Technology*, 47(1): 237-244.
- Oh, S., Yoo, Y., Young, J. and Kim, I. (2001) Effect of organics on sulfur-utilizing autotrophic denitrification under mixotrophic conditions. *Journal of Biotechnology*, 92: 1-8.
- Paul, E. and F. Clark (1989) *Soil Microbiology and Biochemistry*, 2<sup>nd</sup> Edition, pp. 136-137, Academic Press, New York.



- Park, J., Shin, H., Lee, I. and Bae, J. (2002) Denitrification of high  $\text{NO}_3^-$ -N containing wastewater using elemental sulfur; nitrogen loading rate and  $\text{N}_2\text{O}$  production. *Environ. Technology*, 23(1): 56-65.
- Robertson, W.D. (2010) Nitrate removal rates in woodchip media of varying age. *Ecological Engineering* 36, 1581-1587.
- Schipper, L.A., Gold, A.J., Davidson, E.A. (2010a) Managing denitrification in human-dominated landscapes. *Ecological Engineering* 36, 1503-1506.
- Schipper, L.A., Robertson, W.D., Gold, A.J., Jaynes, D.B., Cameron, S.C. (2010b) Denitrifying bioreactors--An approach for reducing nitrate loads to receiving waters. *Ecological Engineering* 36, 1532-1543.
- Schipper, L.A., Cameron, S.C., Warneke, S. (2010c) Nitrate removal from three different effluents using large-scale denitrification beds. *Ecological Engineering* 36, 1552-1557.
- Shan, J. and Zhang, T. (1998) Septic Tank Effluent Denitrification with Sulfur/Limestone Processes, Proceedings of the 1998 Conference on Hazardous Waste Research.
- Sierra-Alvarez, R., Beristain-Cardoso, R., Salazar, M., Gómez, J., Razo-Flores, E., Field, J. (2007) Chemolithotrophic denitrification with elemental sulfur for groundwater treatment. *Water Research*, 41(6): 1253-1262.
- Smith, D. (2006) *Nitrogen Removal from Stormwater: A Pilot Plant Research Project*, World Environmental and Water Resources Congress. American Society of Civil Engineers, Environment and Water Institute: Omaha, Nebraska.
- Smith, D. (2009) *Modular Nitrogen Removal in Distributed Sanitation Water Treatment Systems*. Environmental Engineer American Academy of Environmental Engineers: Annapolis, Maryland.
- Smith, D. (2011) Chabazite Biofilter for Enhanced Stormwater Nitrogen Removal. *Water Environment Research*, 83, 4, April 2011, 373-384, Water Environment Federation, Alexandria, VA.
- Soares, M. (2002) Denitrification of groundwater with elemental sulfur. *Water Research*, 36(5): 1392-1395.
- Stumm, W. and J. Morgan (1996) *Aquatic Chemistry Chemical Equilibria and Rates in Natural Waters*, Third Edition. Environmental Science and Technology Series, John Wiley & Sons, New York.
- Tanaka, Y., Yatagai, A., Masujima, H., Waki, M. and Yokoyama, H. (2007) Autotrophic denitrification and chemical phosphate removal of agro-industrial wastewater by filtration with granular medium. *Bioresource Technology*, 98: 787-791.

- U.S. Environmental Protection Agency (2002) *Methods for Measuring Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (5th Edition)*. EPA-821-R-02-012 October 2002.
- Wardrop, A. (1969) The structure of the cell wall in lignified collenchyma of *Eryngium* sp. *Aust. J. Botany*, 17, 229-240.
- Wang, A., Du, D., Ren, N. and van Groenestijn, J. (2005) An Innovative Process of Simultaneous Desulfurization and Denitrification by *Thiobacillus denitrificans*. *Journal of Environmental Science and Health*, 40: 1939-1949.
- Woli, K.P., David, M.B., Cooke, R.A., McIsaac, G.F., Mitchell, C.A. (2010) Nitrogen balance in and export from agricultural fields associated with controlled drainage systems and denitrifying bioreactors. *Ecological Engineering* 36, 1558-1566.
- Yamamoto-Ikemoto, R. and Komori, T. (2003) Effects of C/N, C/S and S/N Ratios on TOC and Nitrogen Removal in the Sulfate Reduction-Sulfur Denitrification Process. *Journal of Water and Environment Technology* 1(1): 7-12.
- Zeng, H. and Zhang, T. (2005) Evaluation of kinetic parameters of a sulfur–limestone autotrophic denitrification biofilm process. *Water Research*, 39(20): 4941-4952.
- Zhang, T. (2002) Nitrate Removal in Sulfur: Limestone Pond Reactors *Journal of Environmental Engineering*, 128(1): 73-84.
- Zhang, T. (2004) Development of Sulfur-Limestone Autotrophic Denitrification Processes for Treatment of Nitrate-Contaminated Groundwater in Small Communities, Midwest Technology Assistance Center (MTAC), Illinois State Water Survey, Champaign, Illinois.
- Zhang, T. and Lampe, D. (1999) Sulfur: Limestone Autotrophic Denitrification Processes for Treatment of Nitrate-Contaminated Water: Batch Experiments. *Water Research*, 33(3): 599-608.
- Zhang, T.C. and Shan, J. (1999) In Situ Septic Tank Effluent Denitrification Using a Sulfur-Limestone Process *Water Environment Research*, 71, 7, 1283-1291.

c:\44237-001R004\Wpdocs\Report\Final



## **Appendix A: Expanded Clay (Riverlite) Material Data Safety Sheet**

---

PRELIMINARY

o:\44237-001\Wpdocs\Report\Final



Big River Industries, Inc.

## Material Safety Data Sheet

This complies with OSHA'S Hazard Communication Standard 29 CFR 1910.1200

<b>IDENTITY (As used on Label and List)</b> Expanded Clay Lightweight Aggregate	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
--	---

### Section I

<b>Manufacturer's Name</b> Big River Industries, Inc. Louisiana Division	<b>Emergency Telephone Number</b> (225) 627-4242
<b>Address</b> (Number, Street, City, State, and ZIP Code) U.S. Highway 190 W 12652 Airline Hwy	<b>Telephone Number for Information</b> (225) 627-4242
Erwinville, LA 70729	<b>Date Prepared</b> 01/15/12
	<b>Signature of Preparer</b> (optional)

### Section II – Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
SiO <sub>2</sub> SILICON DIOXIDE		10*		64.60
Fe <sub>2</sub> O <sub>3</sub> FERRIC OXIDE		10*		6.55
Al <sub>2</sub> O <sub>3</sub> ALUMINUM OXIDE		10*		20.57
CaO CALCIUM OXIDE		3*		0.84
MgO MAGNESIUM OXIDE		10*		2.91
* Milligrams per cubic meter (Mg/M <sup>3</sup> )				

### Section III – Physical/Chemical Characteristics

<b>Boiling Point</b>	N/A	<b>Specific Gravity (H<sub>2</sub>O = 1)</b>	1.32 (SSD)
<b>Vapor Pressure (mm Hg.)</b>	N/A	<b>Melting Point</b>	2100 F
<b>Vapor Density (AIR = 1)</b>	N/A	<b>Evaporation Rate (Butyl Acetate = 1)</b>	Not Available
<b>Solubility in Water</b> N/A			
<b>Appearance and Odor</b> Reddish, brown angular with no odor			

### Section IV – Fire and Explosion Hazard Data

<b>Flash Point (Method Used)</b> N/A	<b>Flammable Limits</b> N/A	<b>LEL</b> N/A	<b>UEL</b> N/A
<b>Extinguishing Media</b> N/A			
<b>Special Fire Fighting Procedures</b> N/A			
<b>Unusual Fire and Explosion Hazards</b> None known			

### Section V – Reactivity Data

Stability	Unstable		Conditions to Avoid None Known
	Stable	X	
Incompatibility (Materials to Avoid) None Known			
Hazardous Decomposition or Byproducts None Known			
Hazardous Polymerization	May Occur		Conditions to Avoid None Known
	Will Not Occur	X	



## Section VI – Health Hazard Data

<b>Route(s) of Entry:</b>	<b>Inhalation?</b> X	<b>Skin?</b> X	<b>Ingestion?</b> X
<b>Health Hazards</b> ( <i>Acute and Chronic</i> ) Exposure to dust may irritate respiratory system, eyes and skin			
<b>Carcinogenicity:</b> No	<b>NTP?</b> No	<b>IARC Monographs?</b> No	<b>OSHA Regulated?</b> No
<b>Signs and Symptoms of Exposure</b> Irritated eyes from dust, difficulty in breathing, irritated skin.			
<b>Medical Conditions Generally Aggravated by Exposure</b> Respiratory system, irritated eyes or open wounds.			
<b>Emergency and First Aid Procedures</b> Eyes-Flush with running water. Dust Inhalation-Move to fresh air. Skin-Wash with soap and water. Contact physician if irritation persists.			

## Section VII – Precautions for Safe Handling and Use

<b>Steps to Be Taken in Case Material is Released or Spilled</b> Spilled material may generate dust. Wetting will help reduce dust levels. Respiratory protective equipment may be necessary.
<b>Waste Disposal Method</b> Pickup and reuse clean material. Dispose of waste material in accordance with applicable federal, state and local regulations.
<b>Precautions to be Taken in Handling and Storing</b> Respirable dust may be generated during processing, handling or storage. Control measures as outlined in section VIII should be followed.

<b>Other Precautions</b>	None Known

## Section VIII – Control Measures

<b>Respiratory Protection</b> ( <i>Specify Type</i> ) NIOSH – MSHA Approved Dust Respirators		
<b>Ventilation</b>	<b>Local Exhaust</b> X	<b>Special</b> N/A
	<b>Mechanical</b> ( <i>General</i> ) X	<b>Other</b> N/A
<b>Protective Gloves</b> Recommended but not required		<b>Eye Protection</b> Safety glasses with side shields
<b>Other Protective Clothing or Equipment</b> Long sleeves and trousers recommended, but not required.		
<b>Work/Hygienic Practices</b> Wash exposed skin with soap and water. Wash work cloths as necessary.		



## **Appendix B: Lignocellulosic Material Data Safety Sheet**

---

PRELIMINARY

o:\44237-001\Wpdocs\Report\Final

# MATERIAL SAFETY DATA SHEET

## SECTION I: IDENTIFICATION OF PRODUCT

COMPANY: **Diversity Technologies Corp.** DATE: Apr. 1, 2002  
**8750 – 53<sup>rd</sup> Ave.** PHONE: 780-468-4064  
**Edmonton, AB T6E 5G2** FAX: 780-469-1899

PRODUCT NAME: **SAWDUST**

PRODUCT USE: Oil well drilling fluid additive  
CHEMICAL FAMILY: Wood by-product CAS #: None

## WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

WHMIS CLASSIFICATION: Not a controlled product under WHMIS.  
WORKPLACE HAZARD: Not applicable.

## TRANSPORTATION OF DANGEROUS GOODS (TDG)

PROPER SHIPPING NAME: Not regulated under TDG  
TDG CLASSIFICATION: Not applicable  
UN NUMBER (PIN): Not applicable  
PACKING GROUP: Not applicable

## SECTION II: HAZARDOUS INGREDIENTS

<u>INGREDIENT</u>	<u>PERCENT</u>	<u>CAS NUMBER</u>	<u>LD<sub>50</sub> Oral-Rat</u>	<u>LC<sub>50</sub> Inhal-Rat</u>	<u>ACGIH-TLV</u>
-------------------	----------------	-------------------	---------------------------------	----------------------------------	------------------

Contains no WHMIS controlled ingredients

## SECTION III: HEALTH HAZARDS

ROUTE OF ENTRY: ☐ EYE CONTACT ☐ SKIN ☐ INHALATION ☐ INGESTION  
EYE CONTACT: Mechanical irritant.  
SKIN CONTACT: No effects expected. Abrasion may occur with prolonged contact.  
INGESTION: No toxic effects expected.  
INHALATION: Possible irritation of nasal passages, throat and bronchial passages.  
People with existing respiratory problems should avoid wood dust.  
CARCINOGENICTY: Not applicable  
TERATOGENICITY: Not applicable  
REPRODUCTIVE TOXICITY: Not applicable  
MUTAGENICTY: Not applicable

SYNERGISTIC  
PRODUCTS: Not applicable

#### SECTION IV: FIRST AID MEASURES

SKIN CONTACT: Wash with soap and water. If irritation develops, obtain medical attention.

EYE CONTACT: Flush eye to remove debris. If irritation persists, obtain medical attention.

INGESTION: If a large amount is ingested, consult a physician.

INHALATION: Move patient from dusty environment. Apply oxygen or artificial respiration if required. If breathing difficulties or distress continues obtain medical attention.

#### SECTION V: PHYSICAL DATA

APPEARANCE AND ODOUR: Yellow granular flake; woody odour

SPECIFIC GRAVITY: Variable

BOILING POINT (C): Not applicable

MELTING POINT (C): Not applicable

SOLUBILITY IN WATER: Insoluble pH: No data

PERCENT VOLATILE BY VOLUME: Not applicable

EVAPORATION RATE: Not applicable

VAPOUR PRESSURE (mmHg): Not applicable

VAPOUR DENSITY (air = 1) Not applicable

BULK DENSITY: Not applicable

#### SECTION VI: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Not applicable

FLAMMABLE LIMITS: LEL: 40 gm/m<sup>3</sup> UEL: Variable

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, water spray or foam. Suggest water spray for large fires.

SPECIAL FIRE FIGHTING  
PROCEDURES: Self-contained breathing apparatus required for fire fighting personnel. Move containers from fire area, or cool with water spray, if possible.

UNUSUAL FIRE AND  
EXPLOSION HAZARDS: Material will burn under fire conditions. Autoignition temperature = 400-500F.

#### SECTION VII: REACTIVITY DATA

STABILITY: STABLE [XX] UNSTABLE [ ]



INCOMPATIBILITY (CONDITIONS TO AVOID):	Incompatible with oxidizers. Avoid open flames and high temperatures.
CONDITIONS OF REACTIVITY:	Contact with strong oxidizers. May undergo autoignition at high temperatures.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition will result in the following: Water, carbon dioxide, formic acid, acetic acid, carbon monoxide, methane, wood coal and aldehydes.
HAZARDOUS POLYMERIZATION:	WILL NOT OCCUR [XX] MAY OCCUR [ ]

## SECTION VIII: PREVENTATIVE MEASURES

### SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:	Suggest NIOSH approved dust mask. OEL = 5 mg/m <sup>3</sup> for non-allergenic wood dust.
VENTILATION:	General mechanical sufficient for normal conditions of use.
PROTECTIVE GLOVES:	Suggest PVC or rubber.
EYE PROTECTION:	Suggest goggles.
OTHER PROTECTIVE EQUIPMENT (Specify):	Long-sleeve shirt and coveralls. Ensure eye wash station and emergency shower available.

## PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Eye and respiratory protection suggested when handling this material. Store in a cool dry area away from incompatibles and open flames.

## STEPS TO BE TAKEN IN CASE THE MATERIAL IS SPILLED OR RELEASED

Wear suitable protective equipment. Eliminate ignition sources. Sweep up and collect uncontaminated material for repackaging. Sweep up and collect contaminated material in approved containers for disposal.

## WASTE DISPOSAL METHOD

Dispose/incinerate in accordance with all federal, provincial and local regulations. It is the responsibility of the user to determine if material meets the criteria of hazardous waste at the time of disposal.

## SECTION IX: PREPARATION

THE INFORMATION CONTAINED HEREIN IS GIVEN IN GOOD FAITH, BUT NO WARRANTY EXPRESSED OR IMPLIED, IS MADE.

DATE ISSUED: April 1, 2002  
SUPERSEDES: March 29, 1999

BY: Product safety committee

**Diversity Technologies Corp. is the parent company of  
Canamara-United Supply Ltd., Hollimex Products Ltd. and Canamara SDS**

# MATERIAL SAFETY DATA SHEET

## WOOD DUST

Company Name, Address

**TRADE NAME:** Wood Dust  
**SYNONYMS:** None  
**CAS. NO.:** None  
**DESCRIPTION:** Particles generated by any manual or mechanical cutting or abrasion process performed on wood.

### PHYSICAL DATA

Boiling Point .....Not Applicable  
Specific Gravity.....Variable  
(Dependent on wood species and moisture content).  
Vapor Density.....Not Applicable  
% Volatiles by Volume.....Not Applicable  
Melting Point.....Not Applicable  
Vapor Pressure.....Not Applicable  
Solubility in H<sub>2</sub>O (% by wt.).....Insoluble  
Evaporation Rate -  
(Butyl Acetate=1).....Not Applicable  
pH.....Not Applicable  
Appearance & Odor.....Light to dark colored  
granular solid  
Color and odor are dependent on the wood species and time since dust was generated.

### FIRE & EXPLOSION DATA

Flash Point.....Not Applicable  
Autoignition Temperature.....Variable  
(typically 400-500°F)  
Explosive Limits in Air.....40 grams/m<sup>3</sup> (LEL)  
Extinguishing Media.....Water, CO<sub>2</sub>, Sand  
Special Fire Fighting  
Procedures.....Wet down with water  
Wet down wood dust to reduce likelihood of ignition or dispersion of dust into the air.  
Remove burned or wet dust to open area after fire is extinguished.  
Unusual Fire &  
Explosion Hazard.....Strong to severe  
explosion hazard  
(if wood dust "cloud" contacts an ignition source)

### HEALTH EFFECTS DATA

Exposure Limit.....ACGIH TLV<sup>(R)</sup>:  
TWA - 5.0 mg/m<sup>3</sup>;

STEL<sub>(15 min.)</sub> - 10 mg/m<sup>3</sup> (softwood)  
TWA - 1.0 mg/m<sup>3</sup>;  
(certain hardwoods such as beech and oak)  
OSHA PEL: TWA (see Footnote 1) -  
(total dust) - 15.0 mg/m<sup>3</sup>

(respirable factor) - 5.0 mg/m<sup>3</sup>  
Skin & Eye Contact.....Eye Irritation &  
Allergic Contact  
Dermatitis  
(Wood dust can cause eye irritation.  
Various species of wood dust can elicit allergic contact dermatitis in sensitized individuals)

Ingestion.....Not Applicable  
Skin Absorption.....Not known to occur  
Inhalation.....May cause:  
nasal dryness, irritation & obstruction.  
Coughing, wheezing, & sneezing: sinusitis  
& prolonged colds have also been reported.

Chronic Effects.....May cause:  
Wood Dust, depending on species, may cause dermatitis on prolonged repetitive contact; may cause respiratory sensitization and/or irritation. IARC classifies wood dust as a carcinogen to humans (Group 1). This classification is based primarily on IARC's evaluation of increased risk in the occurrence of adenocarcinomas of the nasal cavities and paranasal sinuses associated with exposure to wood dust. IARC did not find sufficient evidence to associate cancers of the oropharynx, hypopharynx, lung, lymphatic and hematopoietic systems, stomach, colon, or rectum with exposure to wood dust.

### REACTIVITY DATA

Conditions Contributing  
to Instability.....Stable  
(under normal Conditions)  
Incompatibility.....Avoid Contact with:

oxidizing agents, drying oils and flame. Product may ignite at temperatures in excess of 400° F.

**Hazardous Decomposition**

Products.....Thermal-oxidative degradation of wood produces: irritating & toxic fumes and gases, including CO, aldehydes and organic acids.

**Conditions Contributing to**

Polymerization.....Not Applicable

## PRECAUTIONS AND SAFE HANDLING

Eye Contact.....Avoid

Skin Contact.....Avoid:

Repeated or Prolonged Contact with Skin. Careful bathing and Clean clothes are indicated after exposure.

Inhalation.....Avoid:

Prolonged or Repeated breathing of Wood Dust in Air.

Oxidizing agents and drying oils.....Avoid contact

Open flame.....Avoid

## GENERALLY APPLICABLE CONTROL MEASURES

Ventilation.....Provide:

adequate general and local exhaust ventilation to maintain healthful working conditions.

Safety Equipment.....Wear goggles or

safety glasses.

Other protective equipment such as gloves and approved dust respirators may be needed depending upon dust conditions.

## EMERGENCY AND FIRST AID PROCEDURES

Eyes.....Flush with water

to remove dust particles. If irritation persists, get medical attention.

Skin.....Get Medical advice

If a rash or persistent irritation or dermatitis occur, get medical advice where applicable before returning to work where wood dust is present.

Inhalation.....Remove to fresh air.

If persistent irritation, severe coughing, breathing difficulties occur, get medical advice before returning to work where wood dust is present.

Ingestion..... Not Applicable

## SPILL/LEAK CLEAN-UP PROCEDURES

Recovery or Disposal.....Clean-up:

Sweep or vacuum spills for recovery or disposal; avoid creating dust conditions. Provide good ventilation where dust conditions may occur. Place recovered wood dust in a container for proper disposal.

## FOOTNOTE

**Footnote 1:** In AFL-CIO v. OSHA 965 F. 2d 962 (11th Cir. 1992), the court overturned OSHA's 1989 Air Contaminants Rule, including the specific PELs for wood dust that OSHA had established at that time. The 1989 PELs were: TWA - 5.0 mg/m<sup>3</sup>; STEL (15 MIN.) - 10.0 mg/m<sup>3</sup> (ALL SOFT AND HARD WOODS, EXCEPT WESTERN RED CEDAR); WESTERN RED CEDAR: TWA - 2.5 mg/m<sup>3</sup>. Wood dust is now officially regulated as an organic dust under the Particulates Not Otherwise Regulated (PNOR) or Inert or Nuisance Dust categories at PELs noted under Health Effects Information section of this MSDS. However, a number of states have incorporated provisions of the 1989 standard in their state plans.

## IMPORTANT

The information and data herein are believed to be accurate and have been compiled from sources believed to be reliable. It is offered for your consideration, investigation and verification. There is no warranty of any kind, express or implied, concerning the accuracy or completeness of the information and data herein. The supplier of this form will not be liable for claims relating to any party's use of or reliance on information and data contained herein regardless of whether it is claimed that the information and data are inaccurate, incomplete or otherwise misleading.



# Sawdust & Shavings

## Material Safety Data Sheet

**Product Name:** Screened Sawdust, Screened Shavings

### SECTION I--DIVISION AND LOCATION

Pioneer Sawdust  
621 Fulton Street  
Salt Lake City, Utah 84104  
Telephone: (801) 972-4432

### SECTION II--HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Ingredients in Product: Kiln Dried White Pine Wood  
Chemical Name and Synonyms: Cellulosic Wood Fibre  
Chemical Family: Cellulose  
Molecular Formula: Complex

### SECTION III--PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: N/A  
Vapor Pressure: N/A  
Vapor Density: N/A  
Solubility in Water: Insoluble  
Specific Gravity: (WATER = 1): <1  
Melting Point: N/A  
Evaporation Rate: N/A  
Appearance: Yellowish particles of wood/sawdust  
Odor: None to typical wood smell

### SECTION IV--FIRE AND EXPLOSION DATA

Flash Point: N/A  
Flammable Limits: Slight when exposed to flames  
Extinguishing Media: Drychemical, Waterspray, Foam  
Special Fire Fighting Procedures: None  
Unusual Fire and Explosion Hazards: Avoid CO2 blast. Spontaneous heating possible. Avoid hot, humid storage. Do not disperse in air, as this could lead to dust explosion.

### SECTION V--REACTIVITY DATA

Stability: Stable  
Incompatibility (Material to Avoid): Strong oxidizing agents  
Hazardous Decomposition or By-products: Unknown  
Hazardous Polymerization: Will not occur

### SECTION VI--HEALTH HAZARD DATA

Permissible Concentrations (AIR): Unknown  
Effects of Overexposure: Allergies, dermatitis (skin irritation)  
Toxicological Properties: Unknown

### EMERGENCY FIRST AID PROCEDURES

Eyes: Flush with large amounts of water, consult an eye physician  
Skin Contact: Wipe off excess, wash with soap and water  
Inhalation: Remove from area  
If Swallowed: Call physician immediately

**TEL**  
(801) 972-4432  
Toll Free: (800) 962-7632

**FAX**  
(801) 975-7076

**EMAIL**  
info@pioneersawdust.com

**Salt Lake City, UT**  
**Headquarters/Distribution Center**  
621 Fulton Street  
Salt Lake City, UT 84104-4327  
PO Box 27861  
Salt Lake City, UT 84127-0861

**San Leandro, CA**  
**DMS Warehouse**  
1956 Williams Street  
San Leandro, CA 94577

www.pioneersawdust.com



**FOR OVER 100 YEARS WE HAVE RECYCLED WOOD WASTE TO PRODUCE QUALITY PRODUCTS**

No trees are fallen to supply us with our sawdust. We recycle clean wood waste to produce our sawdust, shavings and sweeping compounds.



#### **SECTION VII--PRECAUTIONS FOR SAFE HANDLING AND USE**

Procedures for Clean-up: Handle as normal solid waste. Scoop up and place in waste container, vacuum, or wet clean.

Waste Disposal Method: Waste material can be buried in an approved landfill or handled as inert waste in accordance with Federal, State, and Local Environmental Regulations

#### **SECTION VIII--SPECIAL PROTECTION INFORMATION**

Ventilation Type Required (Local, Mechanical, Special): Use adequate ventilation in volume to keep dust concentration below TLV (5mg/m<sup>3</sup>).

Respiratory Protection: NIOSH approved Dust to Mist Respirator

Eye Protection: Safety glasses or goggles

Other Protective Equipment: N/A

#### **SECTION IX--SPECIAL PRECAUTIONS**

Precautions to be Taken in Handling and Storing: Store dry at ambient temperature. Avoid moisture.

Other Precautions: None

.....

We believe the statements, technical information and recommendations contained herein are reliable, but they are given without warranty or guarantee of any kind, express or implied, and we assume no responsibility for any loss, damage, or expense, direct or consequential, arising out of their use.

.....

Preparer: Duncan H. Brockbank

Original Date: 12/04/85 (by Norman L. Brockbank)

Revision Date:

Supersedes:





## **Appendix C: Elemental Sulfur Material Data Safety Sheet**

---

PRELIMINARY

o:\44237-001\Wpdocs\Report\Draft

# MATERIAL SAFETY DATA SHEET

## SECTION 1. PRODUCT AND COMPANY INFORMATION

**Trade Name (as labeled):** CoreSulphur ES99

**Common Name:** Elemental Sulfur 99.5%

**Manufactured By:** CoreSulphur, Inc.  
PO Box 1027  
Arroyo Grande, CA 93421

**Business Phone:** (805) 202-4371

**Emergency Phone:** INFOTRAC – (800) 535-5053

**Date of Preparation:** December, 2009  
Updated September, 2011

## SECTION 2. COMPOSITION AND INFORMATION ON INGREDIENTS

Chemical Name	CAS #	Exposure Limits In Air	
		ACGIH TVL (ppm)	OSHA PEL (ppm)
Sulfur	7704-34-9	NA	NA
NE = Not Established		NA = Not Available	

## SECTION 3. EMERGENCY/HAZARDS OVERVIEW

**Emergency Overview:** Bright yellow colored, free flowing pastille with a possible slight sulfur odor. Dust may cause mild irritation. Sulfur trioxide fumes at temperatures above 1067 °F. Not D.O.T. regulated.

**Symptoms Of Over Exposure:**

**Eyes:** Sulfur dust may cause severe irritation with prolonged exposure.  
**Skin:** Prolonged or repeated exposure to sulfur dust may cause skin irritation.  
**Inhalation:** Sulfur dust may cause breathing difficulties and irritation of mucous membranes.  
**Ingestion:** Solid sulfur can be digested in fairly large amounts without injury.  
**Injection:** Not possible.

## SECTION 4. FIRST-AID MEASURES

<b><u>If Inhaled:</u></b>	Remove to fresh air. If breathing becomes difficult, contact a medical physician. Give artificial respiration if victim is not breathing and obtain immediate medical attention.
<b><u>If Ingested:</u></b>	Seek Medical Attention. Do not induce vomiting unless directed to do so by a medical professional. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. If vomiting occurs, keep head lower than hips to prevent introduction of fluid into the lungs.

<b><u>In Case Of Skin Contact:</u></b>	Wash thoroughly with soap and water. Remove contaminated clothing and wash before reuse. Seek medical attention if skin becomes irritated.
<b><u>In Case Of Eye Contact:</u></b>	Flush immediately with water for at least 15 minutes, lifting the upper and lower eyelids occasionally. Call a physician if eye irritation persists.
Victims of chemical exposure and all rescuers must be taken for medical attention. Take a copy of label and MSDS to physician or health professional with victim.	

## SECTION 5. FIRE-FIGHTING MEASURES

<b>Flash Point:</b>	Pure liquid sulfur, 370 °F. Impure liquid sulfur, 428 °F.
<b>LEL Flammable Limits:</b>	35 gm/m <sup>3</sup> .
<b>UEL Flammable Limits:</b>	1400 gm/m <sup>3</sup> .
<b>Auto Ignition Temperature:</b>	Dust Clouds, 374 °F.
<b>Extinguishing Media:</b>	Use any standard agent suitable for surrounding structural fire or for other chemicals that may be involved. Fine water sprays and/or dry chemical agent. CO <sub>2</sub> , dry chemicals, or sand.
<b>Fire Extinguishing Media to Avoid:</b>	Hoses and extinguishers with pressure streams should be avoided where solid sulfur is dusty or where it may create a further hazard by raising more dust clouds.
<b>Unusual Fire And Explosion Hazards:</b>	Sulfur trioxide fumes at temperatures above 1067 °F. Dust suspended in air is readily ignited by flame, static electricity, or friction spark. Every reasonable step must be taken to minimize dust formation. Dust tight casings should be equipped with explosion relief vents. Sparkless electrical equipment is recommended. Handling equipment must be grounded or bonded to avoid static electricity. Keep away from sources of flame or sparks. Detailed recommendations in Manufacturing Chemists Association SD-74 and National Safety Council 612 Bulletins covering "Sulfur" should be followed when handling GreenSun ES 99.5%.
<b>Special Firefighting Procedures:</b>	Wear positive pressure, self-contained breathing apparatus (SCBA) and goggles. Avoid exposure to smoke or fumes.

## SECTION 6. ACCIDENTAL RELEASE MEASURES

**Spill And Leak Response:** Pick up dry spills by scooping, shoveling, or vacuuming and place into containers for reuse or disposal. The minimum personal protective equipment should include rubber gloves, rubber apron, and chemical goggles. Gas masks or SCBA gear may be required. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Keep material out of sewers, storm drains, and surface waters. Comply with all applicable government regulations on spill reporting, handling, and waste disposal. For landfill disposal, mix with limestone 3 times the weight of sulfur.

## SECTION 7. STORAGE AND HANDLING

**Storage Practices:** Store in a cool (above 40 °F), dry, well-ventilated area away from incompatible materials. Solid becomes corrosive to metals when stored wet. Product will physically break down when exposed to moisture.

**Handling Practices:** Wash thoroughly after handling. Avoid contact with eyes, skin, and clothing. Wash with soap and water after handling.

**Work/Hygiene Practices:** Avoid getting chemicals ON YOU or IN YOU. Wash hands with soap and water after handling chemicals. Do not eat or drink around or while handling chemicals. Keep out of reach of children.

## SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

**Ventilation/Engineering Controls:** Use of local exhaust is recommended at product transfer points and where dusty conditions exist.

**Respiratory Protection:** For normal product handling, use any NIOSH approved air-purifying dust respirator. For extremely dusty conditions, a full facepiece purifying particulate respirator is recommended.

**Eye Protection:** Chemical dust/splash goggles or full-face shield to prevent eye contact. As a general rule, contact lenses should not be worn when working with chemicals because they contribute to the severity of an eye injury.

**Hand Protection:** Wear cotton or canvas protective glove to prevent contact. Rubber gloves may be used if product may become wet or moist.

**Body Protection:** Use body protection appropriate for task. Chemical-resistant coveralls and rubber aprons are generally acceptable.

**Other Protective Measures:** An eyewash and safety shower should be nearby and ready for use.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

<b><u>Appearance:</u></b>	Bright yellow colored pastille.	<b><u>Boiling Point:</u></b>	832 °F.
<b><u>Odor:</u></b>	May have slight sulfur odor.	<b><u>Crystallization Point:</u></b>	NA.
<b><u>pH:</u></b>	Neutral when dry.	<b><u>Freezing Point:</u></b>	246 °F.
<b><u>Water Solubility:</u></b>	Insoluble	<b><u>Vapor Pressure:</u></b>	Solid, less than 0.0001 mm. hg at 68 °F
<b><u>Density:</u></b>	76 lbs/ft <sup>3</sup> .	<b><u>Vapor Density (air = 1):</u></b>	>1.
<b><u>Specific Gravity (H<sub>2</sub>O = 1):</u></b>	Solid, 2.07 gm/ml	NA = Not Available.	

## SECTION 10. STABILITY AND REACTIVITY

**Stability:** Stable.

**Conditions To Avoid:** Fire and dust explosions.

**Incompatibility:** Alkaline materials, or mixtures with chlorates, nitrates, or other oxidizing agents.

**Hazardous Polymerization:** Will not occur.

## SECTION 11. TOXICOLOGICAL INFORMATION

**Toxicity Data:** NA.

**Acute Effects:**

**Eyes:** Mild irritant. May cause redness, tearing and/or burning.  
**Skin:** Mild irritant, especially with prolonged exposure or when in contact with moisture.  
**Ingestion:** Nausea and upset stomach  
**Inhalation:** Moderate irritation of nose and throat from dust. May cause dry coughing, wheezing, chest tightness, and burning of mucous membranes.

**Chronic Effects:** None known.

## SECTION 12. ECOLOGICAL INFORMATION

**Environmental Stability:** Sulfur, is stable in the environment. Its transport in the environment depends upon the exact compound, the pH, the soil type, and the salinity. All work practices should be aimed at eliminating environmental contamination.

## SECTION 13. DISPOSAL CONSIDERATIONS

Do not contaminate lakes, streams, ponds, estuaries, oceans, or other waters by discharge of waste effluents or equipment rinsate. Dispose of waste effluents according to federal, state, and local regulations. For landfill disposal, mix with limestone 3 times the weight of sulfur.

## SECTION 14. TRANSPORTATION INFORMATION

This product is not regulated per CFR 49 (Special Provisions 172.102 pt 30

## SECTION 15. REGULATORY INFORMATION

**SARA Reporting Requirements:** This material does not contain toxic chemicals subject to reporting requirements of Section 313, Title III of the Superfund Amendments and Reauthorization Act of 1986.

**California Proposition 65:** WARNING. This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

## SECTION 16. OTHER INFORMATION

The information and recommendations herein are taken from data contained in independent, industry recognized references including NIOSH, OSHA, ANSI, and NFPA. This information is, as of date listed above, true and accurate to the best of CoreSulphur, Inc. knowledge. It is intended for use by persons possessing technical knowledge and at their own discretion and risk. Since actual use is beyond our control, no guarantee, express or implied, and no liability is assumed by CoreSulphur, Inc. in conjunction with the use of this information. Actual conditions of use and handling may require consideration of information other than, or in addition to, that which is provided herein.



## **Appendix D: EPA Methods 8260 and 504.1 Laboratory Report**

---

PRELIMINARY

o:\44237-001\Wpdocs\Report\Final

Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

July 23, 2014

Work Order: 1405266

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS5-STE						
Matrix		Wastewater						
SAL Sample Number		1405266-16						
Date/Time Collected		05/29/14 12:35						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
<b><u>Volatile Organic Compounds</u></b>								
Acetone	ug/L	100 J4	EPA 8260b	4.0	2.0		06/12/14 19:22	1
Acetone	ug/L	100 J4	EPA 8260	4.0	2.0		06/12/14 19:22	1
Acrylonitrile	ug/L	1.3 U	EPA 8260b	4.0	1.3		06/12/14 19:22	1
Acrylonitrile	ug/L	1.3 U	EPA 8260	4.0	1.3		06/12/14 19:22	1
Benzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Benzene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
Bromobenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Bromochloromethane	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Bromochloromethane	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
Bromodichloromethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Bromodichloromethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Bromoform	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Bromoform	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Bromomethane	ug/L	0.4 U	EPA 8260b	0.8	0.4		06/12/14 19:22	1
Bromomethane	ug/L	0.4 U	EPA 8260	0.8	0.4		06/12/14 19:22	1
2-Butanone	ug/L	2.2 I	EPA 8260b	4.0	2.0		06/12/14 19:22	1
2-Butanone	ug/L	2.2 I	EPA 8260	4.0	2.0		06/12/14 19:22	1
n-Butylbenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
sec-Butylbenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
t-Butylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Carbon disulfide	ug/L	0.5 I	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Carbon disulfide	ug/L	0.5 I	EPA 8260	0.8	0.2		06/12/14 19:22	1
Carbon tetrachloride	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Carbon tetrachloride	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Chlorobenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Chlorobenzene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
Chloroethane	ug/L	0.4 U	EPA 8260b	1.6	0.4		06/12/14 19:22	1
Chloroethane	ug/L	0.4 U	EPA 8260	1.6	0.4		06/12/14 19:22	1
Chloroform	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Chloroform	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Chloromethane	ug/L	0.4 U	EPA 8260b	1.6	0.4		06/12/14 19:22	1
Chloromethane	ug/L	0.4 U	EPA 8260	1.6	0.4		06/12/14 19:22	1
1,2-Dibromoethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,2-Dibromo-3-chloropropane	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 19:22	1
2-Chlorotoluene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
2-Chloroethylvinyl Ether	ug/L	0.5 U	EPA 8260b	1.6	0.5		06/12/14 19:22	1
4-Chlorotoluene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1



Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

July 23, 2014

Work Order: 1405266

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS5-STE						
Matrix		Wastewater						
SAL Sample Number		1405266-16						
Date/Time Collected		05/29/14 12:35						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
Dibromochloromethane	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Dibromochloromethane	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
Dibromomethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Dibromomethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
1,2-Dichlorobenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
1,2-Dichlorobenzene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
1,3-Dichlorobenzene	ug/L	0.07 U	EPA 8260b	0.8	0.07		06/12/14 19:22	1
1,4-Dichlorobenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,4-Dichlorobenzene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
trans-1,4-Dichloro-2-butene	ug/L	0.3 U	EPA 8260	0.8	0.3		06/12/14 19:22	1
trans-1,4-Dichloro-2-butene	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 19:22	1
Dichlorodifluoromethane	ug/L	0.5 U	EPA 8260b	1.6	0.5		06/12/14 19:22	1
1,1-Dichloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,1-Dichloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
1,2-Dichloroethane	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
1,2-Dichloroethane	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
1,1-Dichloroethene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,1-Dichloroethene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
cis-1,2-Dichloroethene	ug/L	0.09 U	EPA 8260	0.8	0.09		06/12/14 19:22	1
cis-1,2-Dichloroethene	ug/L	0.09 U	EPA 8260b	0.8	0.09		06/12/14 19:22	1
trans-1,2-Dichloroethene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
trans-1,2-Dichloroethene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,2-Dichloropropane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,2-Dichloropropane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
2,2-Dichloropropane	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 19:22	1
1,1-Dichloropropene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
cis-1,3-Dichloropropene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
cis-1,3-Dichloropropene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
trans-1,3-Dichloropropene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
trans-1,3-Dichloropropene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Ethylbenzene	ug/L	0.08 U	EPA 8260b	0.8	0.08		06/12/14 19:22	1
Ethylbenzene	ug/L	0.08 U	EPA 8260	0.8	0.08		06/12/14 19:22	1
Hexachlorobutadiene	ug/L	0.4 U	EPA 8260b	0.8	0.4		06/12/14 19:22	1
2-Hexanone	ug/L	2.1 U	EPA 8260b	4.0	2.1		06/12/14 19:22	1
2-Hexanone	ug/L	2.1 U	EPA 8260	4.0	2.1		06/12/14 19:22	1
Iodomethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Iodomethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Isopropylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1

Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

July 23, 2014

Work Order: 1405266

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS5-STE						
Matrix		Wastewater						
SAL Sample Number		1405266-16						
Date/Time Collected		05/29/14 12:35						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
4-Isopropyltoluene	ug/L	0.3 I	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Methyl-t-butyl ether	ug/L	0.2 U	EPA 8260b	1.6	0.2		06/12/14 19:22	1
Methylene Chloride	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Methylene Chloride	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
4-Methyl-2-pentanone	ug/L	2.6 U	EPA 8260b	4.0	2.6		06/12/14 19:22	1
4-Methyl-2-pentanone	ug/L	2.6 U	EPA 8260	4.0	2.6		06/12/14 19:22	1
Naphthalene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
n-Propylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Styrene	ug/L	0.05 U	EPA 8260	0.8	0.05		06/12/14 19:22	1
Styrene	ug/L	0.05 U	EPA 8260b	0.8	0.05		06/12/14 19:22	1
1,1,1,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,1,1,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
1,1,2,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,1,2,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Tetrachloroethene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
Tetrachloroethene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Toluene	ug/L	0.5 I	EPA 8260	0.8	0.09		06/12/14 19:22	1
Toluene	ug/L	0.5 I	EPA 8260b	0.8	0.09		06/12/14 19:22	1
1,2,3-Trichlorobenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,2,4-Trichlorobenzene	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 19:22	1
1,1,1-Trichloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,1,1-Trichloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
1,1,2-Trichloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,1,2-Trichloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Trichloroethene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Trichloroethene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	0.6 U	EPA 8260b**	1.6	0.6		06/12/14 19:22	1
Trichlorofluoromethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Trichlorofluoromethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
1,2,3-Trichloropropane	ug/L	0.4 U	EPA 8260b	0.8	0.4		06/12/14 19:22	1
1,2,3-Trichloropropane	ug/L	0.4 U	EPA 8260	0.8	0.4		06/12/14 19:22	1
1,2,4-Trimethylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
1,3,5-Trimethylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Vinyl acetate	ug/L	0.4 U	EPA 8260	1.6	0.4		06/12/14 19:22	1
Vinyl chloride	ug/L	0.3 U	EPA 8260	1.6	0.3		06/12/14 19:22	1
Vinyl chloride	ug/L	0.3 U	EPA 8260b	1.6	0.3		06/12/14 19:22	1
Xylene-m,p	ug/L	0.2 U	EPA 8260	1.6	0.2		06/12/14 19:22	1
Xylene-m,p	ug/L	0.2 U	EPA 8260b	1.6	0.2		06/12/14 19:22	1

**Hazen and Sawyer**  
**10002 Princess Palm Ave, Suite 200**  
**Tampa, FL 33619**

**July 23, 2014**  
**Work Order: 1405266**

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS5-STE						
Matrix		Wastewater						
SAL Sample Number		1405266-16						
Date/Time Collected		05/29/14 12:35						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
Xylene-o	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 19:22	1
Xylene-o	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 19:22	1
Xylenes- Total	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 19:22	1
Xylenes- Total	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
Total Trihalomethanes	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 19:22	1
1,4-Dioxane	ug/L	0.0	EPA 8260b**				06/12/14 19:22	1
Surrogate for EPA 8260	Dibromofluoromethane	101 %	Limits		65-135			
Pesticide Analyses								
1,2-Dibromo-3-chloropropane	ug/L	0.0054 U	EPA 504.1	0.021	0.0054	06/04/14 09:24	06/04/14 21:43	1
1,2-Dibromoethane	ug/L	0.0054 U	EPA 504.1	0.021	0.0054	06/04/14 09:24	06/04/14 21:43	1
Surrogate for EPA 504.1	2-Bromo-1-chloropropane	122 %	Limits		70-130			
Sample Description		BHS5-ST2						
Matrix		Wastewater						
SAL Sample Number		1405266-17						
Date/Time Collected		05/29/14 12:27						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
Volatile Organic Compounds								
Acetone	ug/L	2.0 U	EPA 8260b	4.0	2.0		06/12/14 20:26	1
Acetone	ug/L	2.0 U	EPA 8260	4.0	2.0		06/12/14 20:26	1
Acrylonitrile	ug/L	1.3 U	EPA 8260b	4.0	1.3		06/12/14 20:26	1
Acrylonitrile	ug/L	1.3 U	EPA 8260	4.0	1.3		06/12/14 20:26	1
Benzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Benzene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Bromobenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Bromochloromethane	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Bromochloromethane	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Bromodichloromethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Bromodichloromethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Bromoform	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Bromoform	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Bromomethane	ug/L	0.4 U	EPA 8260b	0.8	0.4		06/12/14 20:26	1
Bromomethane	ug/L	0.4 U	EPA 8260	0.8	0.4		06/12/14 20:26	1
2-Butanone	ug/L	2.0 U	EPA 8260b	4.0	2.0		06/12/14 20:26	1
2-Butanone	ug/L	2.0 U	EPA 8260	4.0	2.0		06/12/14 20:26	1

**Hazen and Sawyer**  
**10002 Princess Palm Ave, Suite 200**  
**Tampa, FL 33619**

**July 23, 2014**  
**Work Order: 1405266**

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS5-ST2						
Matrix		Wastewater						
SAL Sample Number		1405266-17						
Date/Time Collected		05/29/14 12:27						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
n-Butylbenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
sec-Butylbenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
t-Butylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Carbon disulfide	ug/L	0.5 I	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Carbon disulfide	ug/L	0.5 I	EPA 8260	0.8	0.2		06/12/14 20:26	1
Carbon tetrachloride	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Carbon tetrachloride	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Chlorobenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Chlorobenzene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Chloroethane	ug/L	0.4 U	EPA 8260b	1.6	0.4		06/12/14 20:26	1
Chloroethane	ug/L	0.4 U	EPA 8260	1.6	0.4		06/12/14 20:26	1
Chloroform	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Chloroform	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Chloromethane	ug/L	0.4 U	EPA 8260b	1.6	0.4		06/12/14 20:26	1
Chloromethane	ug/L	0.4 U	EPA 8260	1.6	0.4		06/12/14 20:26	1
1,2-Dibromoethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,2-Dibromo-3-chloropropane	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 20:26	1
2-Chlorotoluene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
2-Chloroethylvinyl Ether	ug/L	0.5 U	EPA 8260b	1.6	0.5		06/12/14 20:26	1
4-Chlorotoluene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Dibromochloromethane	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Dibromochloromethane	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Dibromomethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Dibromomethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,2-Dichlorobenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
1,2-Dichlorobenzene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
1,3-Dichlorobenzene	ug/L	0.07 U	EPA 8260b	0.8	0.07		06/12/14 20:26	1
1,4-Dichlorobenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,4-Dichlorobenzene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
trans-1,4-Dichloro-2-butene	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 20:26	1
trans-1,4-Dichloro-2-butene	ug/L	0.3 U	EPA 8260	0.8	0.3		06/12/14 20:26	1
Dichlorodifluoromethane	ug/L	0.5 U	EPA 8260b	1.6	0.5		06/12/14 20:26	1
1,1-Dichloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,1-Dichloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,2-Dichloroethane	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
1,2-Dichloroethane	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
1,1-Dichloroethene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,1-Dichloroethene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1

Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

July 23, 2014

Work Order: 1405266

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS5-ST2						
Matrix		Wastewater						
SAL Sample Number		1405266-17						
Date/Time Collected		05/29/14 12:27						
Collected by		Josefin Hirst						
Date/Time Received		05/29/14 15:15						
cis-1,2-Dichloroethene	ug/L	0.09 U	EPA 8260b	0.8	0.09		06/12/14 20:26	1
cis-1,2-Dichloroethene	ug/L	0.09 U	EPA 8260	0.8	0.09		06/12/14 20:26	1
trans-1,2-Dichloroethene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
trans-1,2-Dichloroethene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,2-Dichloropropane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,2-Dichloropropane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
2,2-Dichloropropane	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 20:26	1
1,1-Dichloropropene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
cis-1,3-Dichloropropene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
cis-1,3-Dichloropropene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
trans-1,3-Dichloropropene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
trans-1,3-Dichloropropene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Ethylbenzene	ug/L	0.08 U	EPA 8260b	0.8	0.08		06/12/14 20:26	1
Ethylbenzene	ug/L	0.08 U	EPA 8260	0.8	0.08		06/12/14 20:26	1
Hexachlorobutadiene	ug/L	0.4 U	EPA 8260b	0.8	0.4		06/12/14 20:26	1
2-Hexanone	ug/L	2.1 U	EPA 8260b	4.0	2.1		06/12/14 20:26	1
2-Hexanone	ug/L	2.1 U	EPA 8260	4.0	2.1		06/12/14 20:26	1
Iodomethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Iodomethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Isopropylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
4-Isopropyltoluene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Methyl-t-butyl ether	ug/L	0.2 U	EPA 8260b	1.6	0.2		06/12/14 20:26	1
Methylene Chloride	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Methylene Chloride	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
4-Methyl-2-pentanone	ug/L	2.6 U	EPA 8260b	4.0	2.6		06/12/14 20:26	1
4-Methyl-2-pentanone	ug/L	2.6 U	EPA 8260	4.0	2.6		06/12/14 20:26	1
Naphthalene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
n-Propylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Styrene	ug/L	0.05 U	EPA 8260	0.8	0.05		06/12/14 20:26	1
Styrene	ug/L	0.05 U	EPA 8260b	0.8	0.05		06/12/14 20:26	1
1,1,1,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,1,1,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,1,2,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,1,2,2-Tetrachloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Tetrachloroethene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Tetrachloroethene	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Toluene	ug/L	0.09 U	EPA 8260b	0.8	0.09		06/12/14 20:26	1
Toluene	ug/L	0.09 U	EPA 8260	0.8	0.09		06/12/14 20:26	1

**Hazen and Sawyer**  
**10002 Princess Palm Ave, Suite 200**  
**Tampa, FL 33619**

**July 23, 2014**  
**Work Order: 1405266**

## Laboratory Report

Project Name		B-HS4 SE#9						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		<b>BHS5-ST2</b>						
Matrix		<b>Wastewater</b>						
SAL Sample Number		<b>1405266-17</b>						
Date/Time Collected		<b>05/29/14 12:27</b>						
Collected by		<b>Josefin Hirst</b>						
Date/Time Received		<b>05/29/14 15:15</b>						
1,2,3-Trichlorobenzene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,2,4-Trichlorobenzene	ug/L	0.3 U	EPA 8260b	0.8	0.3		06/12/14 20:26	1
1,1,1-Trichloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,1,1-Trichloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,1,2-Trichloroethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
1,1,2-Trichloroethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Trichloroethene	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Trichloroethene	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	0.6 U	EPA 8260b**	1.6	0.6		06/12/14 20:26	1
Trichlorofluoromethane	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Trichlorofluoromethane	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
1,2,3-Trichloropropane	ug/L	0.4 U	EPA 8260b	0.8	0.4		06/12/14 20:26	1
1,2,3-Trichloropropane	ug/L	0.4 U	EPA 8260	0.8	0.4		06/12/14 20:26	1
1,2,4-Trimethylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
1,3,5-Trimethylbenzene	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Vinyl acetate	ug/L	0.4 U	EPA 8260	1.6	0.4		06/12/14 20:26	1
Vinyl chloride	ug/L	0.3 U	EPA 8260b	1.6	0.3		06/12/14 20:26	1
Vinyl chloride	ug/L	0.3 U	EPA 8260	1.6	0.3		06/12/14 20:26	1
Xylene-m,p	ug/L	0.2 U	EPA 8260b	1.6	0.2		06/12/14 20:26	1
Xylene-m,p	ug/L	0.2 U	EPA 8260	1.6	0.2		06/12/14 20:26	1
Xylene-o	ug/L	0.2 U	EPA 8260b	0.8	0.2		06/12/14 20:26	1
Xylene-o	ug/L	0.2 U	EPA 8260	0.8	0.2		06/12/14 20:26	1
Xylenes- Total	ug/L	0.1 U	EPA 8260	0.8	0.1		06/12/14 20:26	1
Xylenes- Total	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
Total Trihalomethanes	ug/L	0.1 U	EPA 8260b	0.8	0.1		06/12/14 20:26	1
1,4-Dioxane	ug/L	0.0	EPA 8260b**				06/12/14 20:26	1
Surrogate for EPA 8260	Dibromofluoromethane	100 %	Limits		65-135			
<b>Pesticide Analyses</b>								
1,2-Dibromo-3-chloropropane	ug/L	0.0055 U	EPA 504.1	0.022	0.0055	06/04/14 09:24	06/04/14 22:04	1
1,2-Dibromoethane	ug/L	0.0055 U	EPA 504.1	0.022	0.0055	06/04/14 09:24	06/04/14 22:04	1
Surrogate for EPA 504.1	2-Bromo-1-chloropropane	111 %	Limits		70-130			



## **Appendix E: Acute Toxicity Bioassay Report**

PRELIMINARY

o:\44237-001\Wpdocs\Report\Final



## Whole Effluent Toxicity Testing Summary Page

Client name: Hazen & Sawyer BHS5-STE

MBL Project/Report # 140578


MBL Sample #	Species	Permit Requirements	Test Results	Passing or Failure
140578-1	<i>Cyprinella leedsii</i>	LC50 > / = 100%	LC50 = 35.4%	Failure
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----

Additional Testing Required:

N/A

Comments:

QA/QC Officer/Reviewer:  
Signature



Date:

6/12/2014

## 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. 1 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:

**Hazen & Sawyer**  
10002 Princess Palm Ave.  
Registry One Bldg. Suite 200  
Tampa, FL 33619

NPDES  
Number: N/A

County: Hillsborough

Non-NPDES (1) N/A Yes

Project N/A

Dates Test(s) Conducted:

Start Date: 05/30/2014

Start Time: 1525 hrs.

End Date: 06/03/2014

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

Name(s) of Person(s)  
Conducting Test(s): (Printed)

Dubravka Mihajlovic, Smiljana Kerkez, Marlena Beck,  
Sutanya Singivipulya, Predrag Mihajlovic, Noel Young, and Ashley Blanchard

QA/QC Officer/Reviewer:  
Signature

Date: 6/12/2014

Laboratory  
Report #/  
Project #:

140578

Sampler's  
Name:  
(Print)

Josefin Hirst and Sean Schmidt

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	05/29/2014 1240 hrs.	140578-1	Grab	1	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----

Type of Refrigerant Used  
for Sample Transportation:

X

Wet  
Ice

N/A

Blue  
Ice

N/A

Other

Samples  
Aerated:

Yes, to increase  
D.O. levels.

Yes  
(Describe)

N/A

No

Sample Delivered By:

N/A

Bus

N/A

Hand

X

Common  
Carrier

Samples  
Filtered:

N/A

Yes  
(Describe)

X

No

Provide Description:

(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.

## Summary of Test Conditions

Type of Test (1)	Test Conc. (%)	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	14 days	CL	0.04 mL 1200 Artemia nauplii/0.1 mL per replicate	Once at renewal	1000 mL	250 mL	Beaker	10	2	24-25
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----

G. Other

N/A

Temperature Readings Were:

N/A

Single

N/A

Multiple

X

Continuous

Description of Control Water:

Synthetic Moderately Hard (Reconstituted)

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
NaCl	05/13/2014-05/17/2014	CL	In-House	5.48 g/L NaCl
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----

(1) Please fill the "Type of Test" Box with the Appropriate Letter:

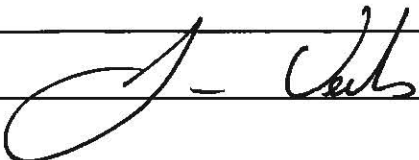
- A. 48-Hr/Non-Renewal/Single Concentration (Screen)  
 B. 48-Hr/Non-Renewal/Multi-Concentration (Definitive)  
 C. 96-Hr/Renewed Every 48-Hrs/Single Concentration (Screen)  
 D. 96-Hr/Renewed Every 48-Hrs/Multi-Concentration (Definitive)  
 E. 7-Day Chronic/Single Concentration (Screen)/Renewed Daily  
 F. 7-Day Chronic/Multi-Concentration (Definitive)/Renewed Daily  
 G. Other - Describe in the "G" Box

(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 *Americamysis bahia* (mysid shrimp)  
 DP *Daphnia pulex*  
 DM *Daphnia magna*  
 CL *Cyprinella leedsii* (bannerfin shiner)  
 Other - Please Describe \_\_\_\_\_

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

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

QA/QC Officer/Reviewer:  
Signature


Date:

6/12/2014

### ACUTE Test Results.

**Test conducted in accordance with EPA-821-R-02-012.**

[illegible]

- (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  $\leq 50\%$  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 5.

\* 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 unreliable result as demonstrated herein.

QA/QC Officer/Reviewer:  
Signature

Date:

6/12/2014

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

[illegible]

**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 NELAP standards.

**This report shall not be reproduced except in full, without the written approval of MBL.**

QA/QC Officer/Reviewer:  
Signature

J. Vals

Date:

6/12/2014

## Acute Fish Test-96 Hr Survival

Start Date: 5/30/2014 Test ID: 140578CL Sample ID: 140578-1  
 End Date: 6/3/2014 Lab ID: MBL-Marinco Bioassay Lab. Sample Type:  
 Sample Date: Protocol: EPA Method #2000.0 Test Species: CL-Cyprinella leedsii  
 Comments: This analysis was performed by Marlena Beck at MBL.

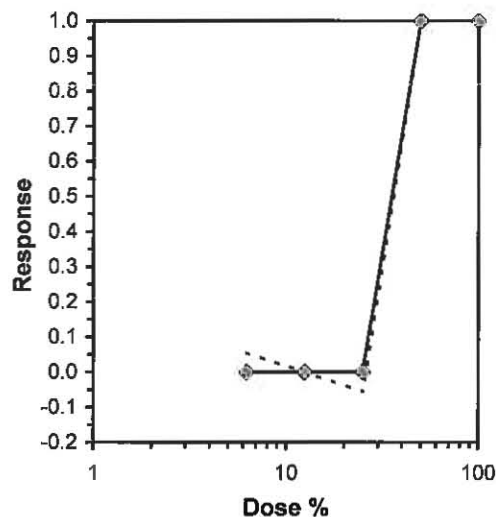
Conc-%	1	2
Control	1.0000	0.8000
6.25	0.9000	0.8000
12.5	0.8000	1.0000
25	1.0000	0.9000
50	0.0000	0.0000
100	0.0000	0.0000

Conc-%	Mean	N-Mean	Transform: Untransformed					N	Number Resp	Total Number
			Mean	Min	Max	CV%				
Control	0.9000	1.0000	0.9000	0.8000	1.0000	15.713	2	2	20	
6.25	0.8500	0.9444	0.8500	0.8000	0.9000	8.319	2	3	20	
12.5	0.9000	1.0000	0.9000	0.8000	1.0000	15.713	2	2	20	
25	0.9500	1.0556	0.9500	0.9000	1.0000	7.443	2	1	20	
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	2	20	20	
100	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	2	20	20	

## Graphical Method

Trim Level EC50  
 0.0% 35.355

35.355



## SURVIVAL BENCH SHEET

Project #: 140578 Test Start: 5/30/14 1525  
 Test Organism: Cyprinella leedsii Test End: 6/3/14 1503  
 Organism Age: 14 days Brood #: CL40516

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	140578-1	10	0	—	—	—	10	0	—	—	—	0
50		10	0	—	—	—	10	0	—	—	—	0
25		10	10	10	10	10	10	10	10	10	9	95
12.5		10	10	8	8	8	10	10	10	10	10	90
6.25		10	10	9	9	9	10	10	9	9	8	85
Control		10	10	10	10	10	10	10	8	8	8	90
Organisms Fed By: (Initials & Time)		SS 5/30 t—	—	SS 0810	—	—	SS 5/30 t—	—	SS 0810	—	—	—
0 Hours started/checked by: 24, 72, 96 Hours counted by: 48 Hours renewed/cleaned by:		SS MB	SS	SS	SC MB	MB	SS MB	SS	SS	SC MB	MB	MB

Comments or Corrections: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Reviewed by: MB  
 Date: 6/4/14



# ACUTE TOXICITY TEST PHYSICAL AND CHEMICAL MEASUREMENTS

EPA Method # 2000.0

Page 8 of 12

Project #: 140578

Test Start: 5/30/14 1525

Test Organism: Cyprinella leedsi

Test End: 6/3/14 1503

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	140578-1	8.0	2.0	/	/	/	8.1	8.1	/	/	/
50.0	/	8.3	3.7	/	/	/	8.1	8.0	/	/	/
25.0	/	8.3	7.0	4.4 8.2	3.0 6.0	6.0	8.1	8.0	7.9 7.8	7.7	7.8
12.5	/	8.3	7.3	4.8 8.2	3.2	7.0	8.0	7.9	7.7 7.9	7.5	7.8
6.25	/	8.3	7.4	6.0 8.1	6.0	7.4	7.9	7.8	7.7 7.9	7.5	7.7
Control	/	8.2	7.4	6.7 8.1	6.8	7.0	7.8	7.8	7.7 7.9	7.7	7.8
Measured by:		SS	MY	PM SS	SL	SL	SS	MY	PM SS	SL	SL

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					Conductivity (µm/cm)				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	140578-1	24	25	/	/	/	1.178	1.102	/	/	/
50.0	/	24	25	/	/	/	0.742	0.721	/	/	/
25.0	/	24	25	25 25	25	25	0.518	-	0.540	-	0.540
12.5	/	24	25	25 25	25	25	0.412	-	0.434	-	0.436
6.25	/	24	25	25 25	25	25	0.356	-	0.379	-	0.387
Control	/	24	25	25 25	25	25	0.300	-	0.324	-	0.344
Measured by:		SS	MY	PM SS	SL	SL	SS	MY	PM SS	-	SL

Comments or corrections: ① Aeration stated on all concentrations, all replicates ~100 bubbles/min. at 1005 SL 6/2/14

Reviewed by: MB

Date: 6/4/14

# SAMPLE/CONTROL WATER INFORMATION

Project #: 140578

## 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		140578-1	354	6/4/14	AB	182	6/4/14	AB				1.178	5/30/14	SS
Control Water	Initial	SMH140528	52	6/4/14	AB	80	6/4/14	AB				0.300	5/30/14	SS
Control Water	Renewal	SMH140530	55	6/4/14	AB	80	6/4/14	AB				0.324	6/1/14	SS

\*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

Sample #	Initial D.O. (mg/L)	Aeration Duration (min.)	Aeration Rate (ml/min.)	Final D.O. (mg/L)	Aerated by: Initials/Date/Time/Volume	Initial Sample pH	Measured by
140578-1	0.8	12	~500	8.0	SS 5/30/14 1440 (1.0)	7.3	SS
140578-1	2.1	N/A	N/A	N/A	SS 6/1/14 1520	7.3	SS

Comments or corrections: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reviewed by: MB

Date: 6/4/14

## ACUTE TEST CONDITIONS

Project #: 140578Client: Hazen + SawyerTest type: CL 96 hr @ defTest 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.
CL	N/A	SS	E	SS	R	SS	1000	SS	250	SS	B	SS

(1) CD *Ceriodaphnia dubia*FM *Pimephales promelas* (fathead minnow)SS *Menidia beryllina* (inland silverside)MS *Americamysis bahia* (mysid shrimp)DP *Daphnia pulex*DM *Daphnia magna*CL *Cyprinella leedsii* (bannerfin shiner)

Other - Please Describe \_\_\_\_\_

(2) Please fill the "Amount &amp; Type of Food" Box with the appropriate letter:

'AA' 0.1 mL Selenastrum per replicate, 0.1 mL YCT per replicate

'A' 0.2 mL Selenastrum per replicate, 0.2 mL YCT per replicate

'B' 1.4 mL Selenastrum/200 mL of sample, 1.4 mL YCT/200 mL of sample

'C' 0.1 mL of 1200 Artemia nauplii/0.1 mL per replicate

'D' 0.085 mL of 1200 Artemia nauplii/0.1 mL per replicate

'E' 0.04 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

'F' Once, at least four 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

Photoperiod: ☒ 16 hours Light/8 hours dark☐ Other \_\_\_\_\_

Test(s) conducted in accordance with EPA-821-R-02-012

Randomization version: 17Method number 2000.0

## Physical and Chemical Measurement Equipment

Equipment type	Test start	24 hours	48 hours	72 hours	96 hours
Thermometer (A)	E	E	E/E	E	E
DO Meter (B)	4	4	4/4	4	4
pH Meter (C)	7	7	7/7	7	7
Conductivity meter (D)	10	10	10	10	10
Freshwater cond. checked by	-	-	-	-	-
Used by (Initials)	SS	MY	PM/SS	SK	SLC

(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: Test moved to EC #2Reviewed by: MBDate: 6/14/14

## Chain of Custody Record

*Please use black ink only*

Client: Hazen & Sawyer Permit #: \_\_\_\_\_

Samplers (Print Names): Josefin Hirst  
Sean Schmidt

### Sample Containers

1 qt.	2 qt.	1 Gal.
	3	
Sample Cooler #: <u>1</u>		

### Tests Required

Acute:	<u>96-HR Cyprinella leedsii</u>
Chronic:	

### Client Provided Information

THC	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.
	BH54-STF	5	5/29/14	11:50	Grab	1	yes		
	BH55-ST2	6	5/29/14	12:30	Grab	1	yes		
	BH55-STF	7	5/29/14	12:40	Grab	1	yes	140578-1	10°C

### Lab Use Only

### Sampling Kit Transfers

Relinquished By:	Received By:	Date	Time	Count
MBL: <u>[Signature]</u>	Carrier: <u>FedEx</u>	<u>5/23/14</u>	<u>1530</u>	<u>3</u>
Carrier: <u>FedEx</u>	Client: <u>[Signature]</u>	<u>5/27/14</u>	<u>1200</u>	<u>3</u>

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

### Sample Transfers

Relinquished By:	Received By:	Date	Time	Count
Person's Name: <u>Josefin Hirst</u> Facility Name: <u>Hazen and Sawyer</u>	Person's Name: <u>Scott McCullough</u> Facility Name: <u>American Courier</u>	<u>5/29/14</u>	<u>8:52 AM</u>	<u>3</u>
Person's Name: <u>Scott McCullough</u> Facility Name: <u>American Courier</u>	Person's Name: <u>[Signature]</u> Facility Name: <u>[Signature]</u>	<u>5/30/14</u>	<u>1010</u>	<u>3</u>
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 : American Courier Busbill/Airbill #: 22912

# INTERNAL CHAIN OF CUSTODY

## MARINCO BIOASSAY LABORATORY, INC.

### Acute Toxicity Test

Project # 140578

Sample expiration date/time 5/31/14 0000

Sample #(s)	<u>140578 -1</u>	<u>140578-1</u>
Procedure	Test Start	Test Renewal
Sample(s) checked in by Initials/Date/Time	<u>MB 5/30/14</u> <u>1010</u>	<u>N/A</u>
Sample(s) warmed by Initials/Date/Time	<u>SS 5/30/14</u> <u>1320</u>	<u>SS 6/1/14</u> <u>1430</u>
Total Residual Chlorine measured by Initials/Date/Time	<u>N/A</u>	<u>N/A</u>
Sample(s) salted to test salinity using HW Marinemix by: Initials/Date/Time	<u>N/A</u>	<u>N/A</u>
Dilutions prepared by: Initials/Date/Time	<u>MM 5/30/14</u> <u>1505</u>	<u>SS 6/1/14</u> <u>1525</u>
Test Start-test started by: Test renewal-test renewed by: Initials/Date/Time	<u>SS 5/30/14</u> <u>1525</u>	<u>SS 6/1/14</u> <u>1530</u>
Remaining sample(s) returned to refrigerator by: Initials/Date/Time	<u>MM 5/30/14</u> <u>1505</u>	<u>N/A</u>
Samples disposed of by & disposal method Initials/Date/Time	<u>N/A</u>	<u>Sample consumed in test</u> <u>SS 6/1/14 1525</u>

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: MB Date: 6/10/14

## Whole Effluent Toxicity Testing Summary Page

Client name: Hazen & Sawyer BHS5-ST2

MBL Project/Report # 140577

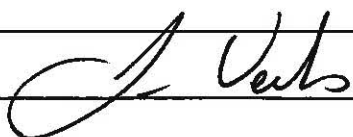
MBL Sample #	Species	Permit Requirements	Test Results	Passing or Failure
140577-1	<i>Cyprinella leedsii</i>	LC50 > / = 100%	LC50 > 100%	Passing
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----

Additional Testing Required:

N/A

Comments:

QA/QC Officer/Reviewer:  
Signature



Date:

6/12/2014



## 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. 1 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:

**Hazen & Sawyer**  
10002 Princess Palm Ave.  
Registry One Bldg. Suite 200  
Tampa, FL 33619

NPDES  
Number:

N/A

County:

**Hillsborough**

Non-NPDES (1)

N/A

Yes

Project

N/A

Dates Test(s) Conducted:

Start Date:

**05/30/2014**

Start  
Time:

**1535 hrs.**

End Date:

**06/03/2014**

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

Name(s) of Person(s)  
Conducting Test(s): (Printed)

**Dubravka Mihajlovic, Smiljana Kerkez, Marlena Beck,  
Sutanya Singivipulya, Predrag Mihajlovic, Noel Young, and Ashley Blanchard**

QA/QC Officer/Reviewer:  
Signature

Date:

**6/12/2014**

Laboratory  
Report #/  
Project #:

**140577**

Sampler's  
Name:  
(Print)

**Josefin Hirst and Sean Schmidt**

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
<b>1</b>	<b>05/29/2014 1230 hrs.</b>	<b>140577-1</b>	<b>Grab</b>	<b>1</b>	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----
--	-----	-----	-----	---	-----	-----	-----

Type of Refrigerant Used  
for Sample Transportation:

**X**

Wet  
Ice

**N/A**

Blue  
Ice

**N/A**

Other

Samples  
Aerated:

Yes, to increase  
D.O. levels.

Yes  
(Describe)

**N/A**

No

Sample Delivered By:

**N/A**

Bus

**N/A**

Hand

**X**

Common  
Carrier

Samples  
Filtered:

N/A

Yes  
(Describe)

**X**

No

Provide Description:

(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.



## Summary of Test Conditions

Type of Test (1)	Test Conc. (%)	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	14 days	CL	0.04 mL 1200 Artemia nauplii/0.1 mL per replicate	Once at renewal	1000 mL	250 mL	Beaker	10	2	24-25
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----
-	-----	-----	---	-----	-----	-----	-----	-----	-----	---	-----

G. Other

N/A

Temperature Readings Were:

N/A

Single

N/A

Multiple

X

Continuous

Description of Control Water:

Synthetic Moderately Hard (Reconstituted)

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
NaCl	05/13/2014-05/17/2014	CL	In-House	5.48 g/L NaCl
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----
-----	-----	-----	-----	-----

(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

(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 *Americamysis bahia* (mysid shrimp)  
 DP *Daphnia pulex*  
 DM *Daphnia magna*  
 CL *Cyprinella leedsii* (bannerfin shiner)  
 Other - Please Describe \_\_\_\_\_

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

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

QA/QC Officer/Reviewer:  
Signature


Date:

6/12/2014

**ACUTE Test Results.**  
**Test conducted in accordance with EPA-821-R-02-012.**

Test Species	Test Concentration (%)	Sample # (3) & Sample I.D.	% Mortality 24 Hrs (4)	% Mortality 48 Hrs (4)	% Mortality 96 Hrs (4)	LC50 (5)
CL-Control	0	-----	----	----	0	----
CL	6.25, 12.5, 25, 50, 100	140577-1	----	----	-----	> 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)
--	----
--	----
--	----
--	----

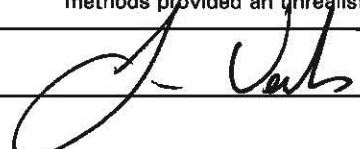
(5) If multi-concentration (Definitive) tests are conducted on grab or composite samples, record the calculated LC50 in this column for each sample. Enter "N/A" in all % Mortality columns and LC50 box at bottom of this table.

(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 5.

\* 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 unreliable result as demonstrated herein.

QA/QC Officer/Reviewer:  
Signature



Date:

6/12/2014

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 NELAP standards.

**This report shall not be reproduced except in full, without the written approval of MBL.**

QA/QC Officer/Reviewer:  
Signature



Date:

6/12/2014

## SURVIVAL BENCH SHEET

Project #: 140577 Test Start: 5/30/14 1535  
 Test Organism: Cyprinella leedsii Test End: 6/3/14 1508  
 Organism Age: 14 days Brood #: CL140516

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	140577-1	10	10	10	10	10	10	9	9	8	8	90
50		10	10	10	10	9	10	10	10	10	10	95
25		10	10	9	8	7	10	8	8	8	8	75
12.5		10	9	9	9	9	10	10	10	10	10	95
6.25		10	10	10	10	9	10	87 245/31	7	7	7	80
Control		10	10	10	10	10	10	10	10	10	10	100
Organisms Fed By: (Initials & Time)		—	—	S 0810	—	—	—	—	SS 0810	—	—	—
0 Hours started/checked by: 24, 72, 96 Hours counted by: 48 Hours renewed/cleaned by:		SS MB	MM	SS	M	MB	SS MB	MM	SS	M	MB	MB

Comments or Corrections: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Reviewed by: MBDate: 6/10/14

# ACUTE TOXICITY TEST PHYSICAL AND CHEMICAL MEASUREMENTS

EPA Method # 2000.0

Page 7 of 11

Project #: 140577

Test Start: 5/30/14 1535

Test Organism: Cyprinella leedsi

Test End: 6/3/14 1508

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	140577-1	7.5	7.4	<del>7.3</del> 7.6	6.4	5.9	7.9	8.2	<del>8.6</del> 7.9	8.5	8.4
50.0		8.1	7.5	<del>7.1</del> 8.1	6.1	6.3	8.0	8.2	<del>8.4</del> 7.9	8.2	8.1
25.0		8.3	7.6	<del>6.8</del> 8.2	6.0	6.2	7.9	8.1	<del>8.2</del> 8.0	8.2	8.0
12.5		8.3	7.9	<del>5.2</del> 8.2	6.1	6.3	7.9	8.0	<del>7.7</del> 8.0	7.9	7.8
6.25		8.3	7.6	<del>5.4</del> 8.2	6.6	6.5	7.9	7.8	<del>7.6</del> 8.0	7.7	7.7
Control		8.3	7.5	<del>6.9</del> 8.1	6.8	6.6	7.8	7.8	<del>7.8</del> 7.9	7.7	7.7
Measured by:		SS	MY	<del>PM</del> SS	SL	SL	SS	MY	<del>PM</del> SS	SL	SL

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					Conductivity (µm/cm)				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	140577-1	24	25	<del>25</del> 25	25	25	1.240	-	<del>1.240</del>	-	1.284
50.0		24	25	<del>25</del> 25	25	25	0.782	-	<del>0.786</del>	-	0.820
25.0		24	25	<del>25</del> 25	25	25	0.540	-	<del>0.563</del>	-	0.591
12.5		24	25	<del>25</del> 25	25	25	0.425	-	<del>0.442</del>	-	0.468
6.25		24	25	<del>25</del> 25	25	25	0.363	-	<del>0.383</del>	-	0.414
Control		24	25	<del>25</del> 25	25	25	0.299	-	<del>0.324</del>	-	0.342
Measured by:		SS	MY	<del>PM</del> SS	SL	SL	SS	-	<del>SS</del>	-	SL

Comments or corrections: \_\_\_\_\_

Reviewed by: MB

Date: 6/10/14

## SAMPLE/CONTROL WATER INFORMATION

Project #: 140577

## 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		140577-1	280	6/4/14	AB	454	6/4/14	AB				1.240	5/30/14	SS
Control Water	Initial	SMH140528	52	6/4/14	AB	80	6/4/14	AB				0.299	5/30/14	SS
Control Water	Renewal	SMH140530	55	6/4/14	AB	80	6/4/14	AB				0.324	6/1/14	SS

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

## Sample Aeration

Sample #	Initial D.O (mg/L)	Aeration Duration (min.)	Aeration Rate (mL/min.)	Final D.O (mg/L)	Aerated by: Initials/Date/Time/Volume	Initial Sample pH	Measured by
140577-1	1.3	9.0	~500	7.5	SS 5/30/14 1420 (1.0L)	6.8	SS
140577-1	5.5	6.0	~500	7.6	SS 6/1/14 1525 (1.0L)	6.9	SS

Comments or corrections:

Reviewed by: MB

Date: 6/10/14

# ACUTE TEST CONDITIONS

Project #: 140577 Client: Hazen + Sawyer

Test type: CL 96 hr @ def Test run in Environmental Chamber #: 2

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.
CL	N/A	SS	E	SS	2	SS	1000	SS	250	SS	B	SS

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

(2) Please fill the "Amount & Type of Food" Box with the appropriate letter:  
 'AA' 0.1 mL Selenastrum per replicate, 0.1 mL YCT per replicate  
 'A' 0.2 mL Selenastrum per replicate, 0.2 mL YCT per replicate  
 'B' 1.4 mL Selenastrum/200 mL of sample, 1.4 mL YCT/200 mL of sample  
 'C' 0.1 mL of 1200 Artemia nauplii/0.1 mL per replicate  
 'D' 0.085 mL of 1200 Artemia nauplii/0.1 mL per replicate  
 'E' 0.04 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  
 'F' Once, at least four 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

Photoperiod: SS 16 hours Light/8 hours dark  
— Other \_\_\_\_\_

Test(s) conducted in accordance with EPA-821-R-02-012

Randomization version: 18

Method number 2000.0

## Physical and Chemical Measurement Equipment

Equipment type	Test start	24 hours	48 hours	72 hours	96 hours
Thermometer (A)	E	E	E/E	E	E
DO Meter (B)	4	4	4/4	4	4
pH Meter (C)	7	7	7/7	7	7
Conductivity meter (D)	10	—	—/10	—	10
Freshwater cond. checked by	—	—	—/—	—	—
Used by (Initials)	SS	my	PM/SS	SL	SL

(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: MB

Date: 6/10/14



## 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: Hazen & Sawyer

Permit #: \_\_\_\_\_

Samplers (Print Names): Josefin HirstSean Schmidt

## Sample Containers

1 qt.	2 qt.	1 Gal.
	3	
Sample Cooler #: <u>1</u>		

## Tests Required

Acute:  
96-HR Cyprinella leedsii  
 Chronic:

## Client Provided Information

TBC	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.
	BH54-ST6	5	5/29/14	11:50	Grab	1	yes		
	BH55-ST2	6	5/29/14	12:30	Grab	1	yes	140577H	1°C
	BH55-ST6	7	5/29/14	12:40	Grab	1	yes		

## Lab Use Only

## Sampling Kit Transfers

Relinquished By:	Received By:	Date	Time	Count
MBL: <u>[Signature]</u>	Carrier: <u>FedEx</u>	<u>5/23/14</u>	<u>1530</u>	<u>3</u>
Carrier: <u>FedEx</u>	Client: <u>[Signature]</u>	<u>5/27/14</u>	<u>1200</u>	<u>3</u>

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

## Sample Transfers

Relinquished By:	Received By:	Date	Time	Count
Person's Name: <u>Josefin Hirst</u> Facility Name: <u>Hazen and Sawyer</u>	Person's Name: <u>Scott McCullough</u> Facility Name: <u>American Courier</u>	<u>5/29/14</u>	<u>8:52 AM</u>	<u>3</u>
Person's Name: <u>Scott McCullough</u> Facility Name: <u>American Courier</u>	Person's Name: <u>[Signature]</u> Facility Name: <u>[Signature]</u>	<u>5/30/14</u>	<u>1010</u>	<u>3</u>
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 : American CourierBusbill/Airbill #: 22912



# **INTERNAL CHAIN OF CUSTODY** **MARINCO BIOASSAY LABORATORY, INC.**

## **Acute Toxicity Test**

Project #

140577

Sample expiration date/time

5/31/14 0030

Sample #(s)	<u>140577 -1</u>	<u>140577 -1</u>
Procedure	Test Start	Test Renewal
Sample(s) checked in by Initials/Date/Time	<u>MB 5/30/14</u> <u>1010</u>	<u>N/A</u>
Sample(s) warned by Initials/Date/Time	<u>SS 5/30/14</u> <u>1320</u>	<u>SS 6/1/14</u> <u>1430</u>
Total Residual Chlorine measured by Initials/Date/Time	<u>N/A</u>	<u>N/A</u>
Sample(s) salted to test salinity using HW Marinemix by: Initials/Date/Time	<u>N/A</u>	<u>N/A</u>
Dilutions prepared by: Initials/Date/Time	<u>MM 5/30/14</u> <u>1455</u>	<u>SS 6/1/14</u> <u>1545</u>
Test Start-test started by: Test renewal-test renewed by: Initials/Date/Time	<u>SS 5/30/14</u> <u>1535</u>	<u>SS 6/1/14</u> <u>1555</u>
Remaining sample(s) returned to refrigerator by: Initials/Date/Time	<u>MM 5/30/14</u> <u>1505</u>	<u>N/A</u>
Samples disposed of by & disposal method Initials/Date/Time	<u>N/A</u>	<u>Sample consumed in test</u> <u>SS 6/1/14 1545</u>

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

MB


Date:

6/10/14

***Cyprinella leedsi* Acute Standard Reference Toxicant (SRT) Report.**

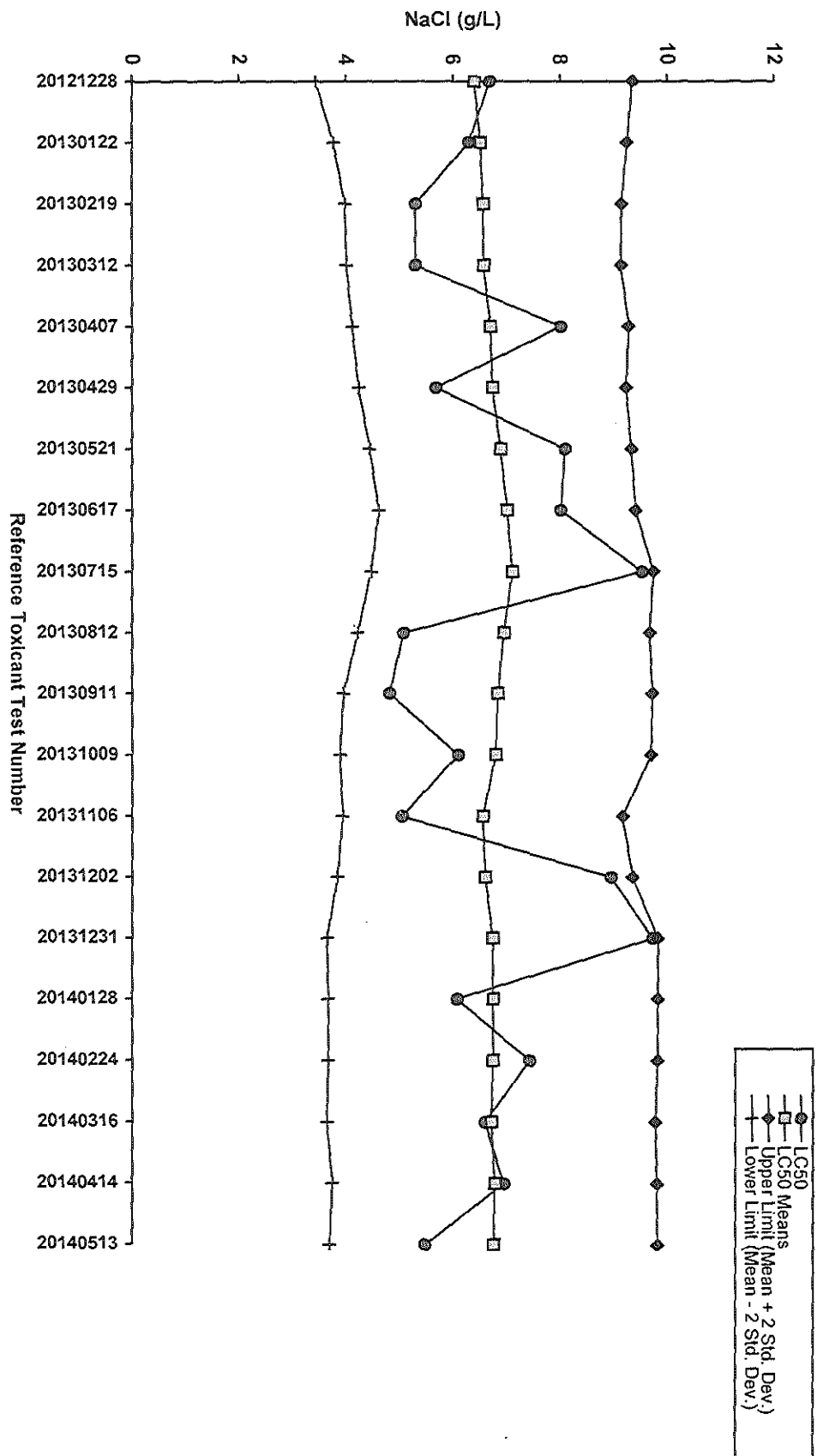
This quality control test was conducted by Marincio Bioassay Laboratory, Inc. personnel using Whole Effluent Toxicity (WET) Test method number 2000.0

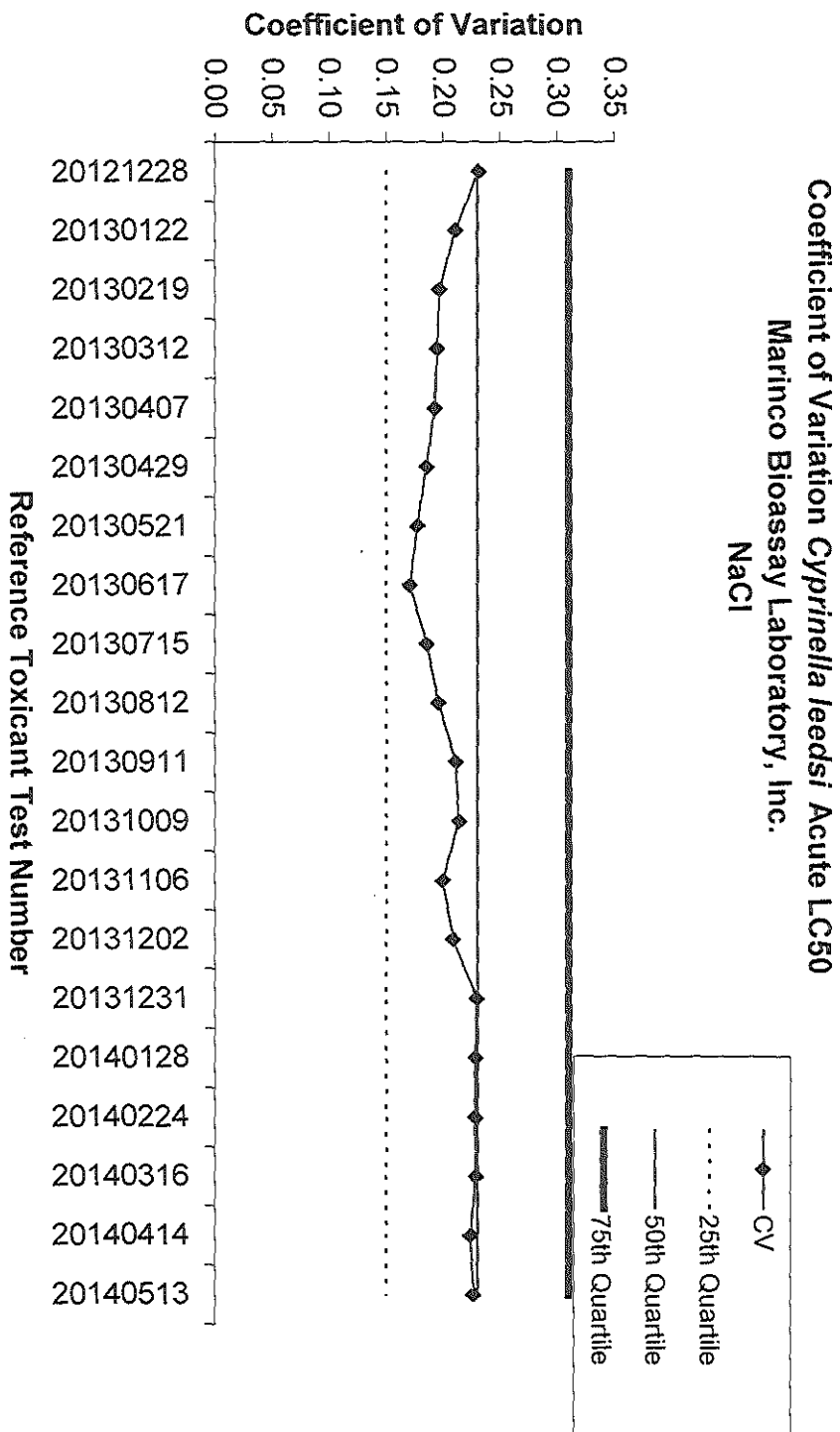
SRT Test No. 14051301A SRT

Reviewed by: 

Date: 5/22/14

STANDARD REFERENCE TOXICANT (SODIUM CHLORIDE) CONTROL CHART FOR *Cyprinella leeds* 96-HOUR  
ACUTE TOXICITY TESTS CONDUCTED AT MARINCO BIOASSAY LABORATORY, INC.





# Acute Fish Test-96 Hr Survival

Start Date: 5/13/2014 Test ID: 140513CLACSRT Sample ID: 15.5 g/L NaCl  
End Date: 5/17/2014 Lab ID: MBL-Marinco Bioassay Lab. Sample Type: NACL-Sodium chloride  
Sample Date: Protocol: EPA Method #2000.0 Test Species: CL-Cyprinella leedsii  
Comments: This analysis was performed by Marlena Beck at MBL.

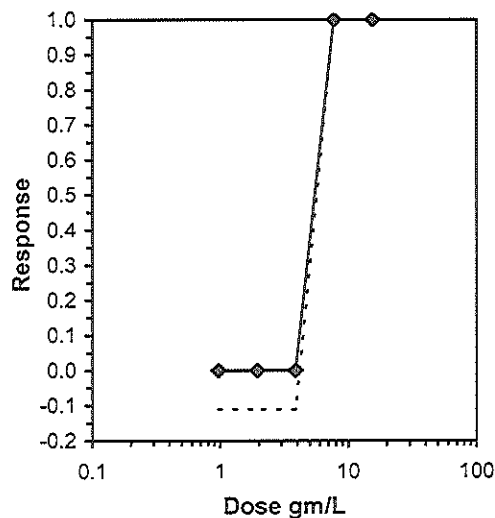
Conc-gm/L	1	2
Control	0.9000	0.9000
0.969	1.0000	1.0000
1.94	1.0000	1.0000
3.88	1.0000	1.0000
7.75	0.0000	0.0000
15.5	0.0000	0.0000

Conc-gm/L	Mean	N-Mean	Transform: Untransformed					N	Number Resp	Total Number
			Mean	Min	Max	CV%				
Control	0.9000	1.0000	0.9000	0.9000	0.9000	0.000	2	2	20	
0.969	1.0000	1.1111	1.0000	1.0000	1.0000	0.000	2	0	20	
1.94	1.0000	1.1111	1.0000	1.0000	1.0000	0.000	2	0	20	
3.88	1.0000	1.1111	1.0000	1.0000	1.0000	0.000	2	0	20	
7.75	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	2	20	20	
15.5	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	2	20	20	

## Graphical Method

Trim Level EC50  
0.0% 5.4836

5.4836



# SURVIVAL BENCH SHEET

Project #: 140513CLACSRT

Test Start: 5/13/14 1245

Test Organism: Cyprinella leedsii

Test End: 5/17/14 1240

Organism Age: 4, 13 days  
misio

Brood #: C2140429

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	15.5g/L NaCl	10	0	—	—	—	10	0	—	—	—	0
50		10	6	1	1	0	10	10	1	1	0	0
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	9	9	9	9	10	9	9	9	9	90
Organisms Fed By: (Initials & Time)		—	—	0810 my	—	—	—	—	0810 my	—	—	—
0 Hours started/checked by: 24, 72, 96 Hours counted by: 48 Hours renewed/cleaned by:		my gp	my	1405 my	my	my	my gp	my	1405 my	my	my	my

Comments or Corrections: \_\_\_\_\_

Reviewed by: MB

Date: 5/22/14

# ACUTE TOXICITY TEST PHYSICAL AND CHEMICAL MEASUREMENTS

Page 6 of 8

EPA Method # 2000.0

Project #: 140513CLACSRT

Test Start: 5/13/14 1245

Test Organism: Cyprinella leedsii

Test End: 5/17/14 1240

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	15.5g/L NaCl	7.8	6.3	<del>7.8</del>			7.6	7.5	<del>7.6</del>		
50.0	<div></div>	7.8	7.0	<del>6.9</del> 8.0	7.2	7.2	7.7	7.6	<del>7.4</del> 7.5	7.8	7.7
25.0		8.0	7.4	<del>7.0</del> 8.1	6.7	6.8	7.7	7.8	<del>7.5</del> 7.6	7.6	7.5
12.5		8.0	7.4	<del>6.9</del> 8.2	6.6	6.8	7.8	7.8	<del>7.5</del> 7.6	7.6	7.6
6.25		8.1	7.4	<del>7.0</del> 8.2	7.0	7.1	7.8	7.8	<del>7.5</del> 7.7	7.7	7.7
Control		8.0	7.3	<del>7.2</del> 8.1	7.0	7.1	7.9	7.8	<del>7.6</del> 7.8	7.8	7.7
Measured by:		my	my	<del>my</del> my	my	my	my	my	<del>my</del> my	my	my

Effluent Concentration %	Sample Number	Temperature (Degrees Celsius)					Conductivity (ms/cm)				
		0 Hours	24 Hours	48 Hours	72 Hours	96 Hours	0 Hours	24 Hours	48 Hours	72 Hours	96 Hours
100	15.5g/L NaCl	25	25	<div></div>			26.8	26.4	<div></div>		
50.0	<div></div>	25	25	<div>25</div> <div>25</div>	25	25	14.28	—	<div></div> <div>14.20</div>	—	14.93
25.0		25	25	<div>25</div> <div>25</div>	25	25	7.39	—	<div></div> <div>7.37</div>	—	7.82
12.5		25	25	<div>25</div> <div>25</div>	25	25	3.99	—	<div></div> <div>4.00</div>	—	4.22
6.25		25	25	<div>25</div> <div>25</div>	25	25	2.21	—	<div></div> <div>2.22</div>	—	2.35
Control		25	25	<div>25</div> <div>25</div>	25	25	0.323	—	<div></div> <div>0.322</div>	—	0.348
Measured by:		my	my	<div>my</div> <div>my</div>	my	my	my	my	<div></div> <div>my</div>	—	my

Comments or corrections: \_\_\_\_\_

Reviewed by: MB

Date: 5/22/14

## SRT Tracking Sheet

Test ID: 140513CLACSRTTest LC50: 5.48 g/L NaClTest Species: Cyprinella leedsiTest NOEC: N/ATest Dates : 5/13/14 to 5/17/14Test IC25: N/A

## SRT Solution Data

Test Concentration and Toxicant: <u>15.5 g/L NaCl lot # VL13L</u>						
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
<u>15.52003</u>	<u>my 5/13/14</u>	<u>1.0</u>	<u>my 5/13/14</u>	<u>26.8</u>	<u>my 5/13/14</u>	<u>Precisa my 5/13/14</u>
<u>7.74993</u>	<u>my 5/15/14</u>	<u>0.5</u>	<u>my 5/15/14</u>	<u>26.9</u>	<u>my 5/15/14</u>	<u>Mettler my 5/15/14</u>

## 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
<u>SMH140511A</u>	<u>55</u>	<u>AB5/13/14</u>	<u>80</u>	<u>AB5/13/14</u>	<u>0.323</u>	<u>my 5/13/14</u>

Comments or Corrections: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reviewed by: MBDate: 5/22/14



# ACUTE TEST CONDITIONS

Project #: 140513X LACSPT

Client:                     

Test type: CL 96 hr @ def.

Test run in Environmental Chamber #: 2

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

(1) CD *Ceriodaphnia dubia*

FM *Pimephales promelas* (fathead minnow)

SS *Menidia beryllina* (inland silverside)

MS *Americamysis bahia* (mysid shrimp)

DP *Daphnia pulex*

DM *Daphnia magna*

CL *Cyprinella leedsii* (bannerfin shiner)

Other - Please Describe                     

(2) Please fill the "Amount &amp; Type of Food" Box with the appropriate letter:

'AA' 0.1 mL Selenastrum per replicate, 0.1 mL YCT per replicate

'A' 0.2 mL Selenastrum per replicate, 0.2 mL YCT per replicate

'B' 1.4 mL Selenastrum/200 mL of sample, 1.4 mL YCT/200 mL of sample

'C' 0.1 mL of 1200 Artemia nauplii/0.1 mL per replicate

'D' 0.085 mL of 1200 Artemia nauplii/0.1 mL per replicate

'E' 0.04 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

'F' Once, at least four 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

Photoperiod: ny 16 hours Light/8 hours dark

☐

Other                     

Test(s) conducted in accordance with EPA-821-R-02-012

Randomization version: 18

Method number 2000.0

## Physical and Chemical Measurement Equipment

Equipment type	Test start	24 hours	48 hours	72 hours	96 hours
Thermometer (A)	D	E	E/E	E	E
DO Meter (B)	4	4	4/4	4	4
pH Meter (C)	7	7	7/7	7	7
Conductivity meter (D)	10	10	10	N/A	10
Freshwater cond. checked by	—	—	—	—	—
Used by (Initials)	ny	ny	ny/ny	ny	ny

(A) Thermometer number is the serial number or designated number on thermometer.

(B) DO Meters: "3" Orion 830  
"4" Hach Senson 6  
"5" Orion 830A  
"6" Orion 820

(C) pH Meters "7" Hach Senson 2  
"8" Orion 290A  
"9" Orion 720

(D) Conductivity "10" Orion 160  
"11" Orion 126

"O" Other                     

Comments or Corrections:                     

Reviewed by: MB

Date: 5/23/14