

**APPENDIX E**

**RESISTIVITY AND CHEMICAL LABORATORY TESTS**

**APPENDIX E  
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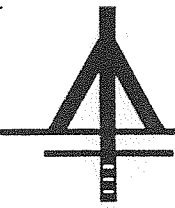
**COMPOSITE SAMPLES TABLE E-1**

TABLE E-1

**LIGO  
COMPOSITE SAMPLES FOR RESISTIVITY  
AND CHEMICAL ANALYSIS**

Composite Number	Boring Number	Depth (ft)	PI
1	BSE-2-GT	10-11	
	BSE-2-GT	18.5-20	
	BSE17-GT	6-8	
2	BSE-1-GT	14-16	
	BSE-24-GT	8-10	
	BSE-33-GT	13-5	
3	BSE-20-GT	6-8	
	BSE-6-GT	6-8	
	BSW-21-GT	8-10	
	BSW-21-GT	4-6	
	BSW-17-GT	6-8	
	BSE-1-GT	8-10	
	BSE-14-GT	8-10	

**CHEMICAL ANALYSIS TEST RESULTS**



# STE

Soil Testing Engineers, Inc.

316 HIGHLANDIA DRIVE • P.O. BOX 83710 • BATON ROUGE, LOUISIANA 70884  
TELEPHONE (504) 752-4790 • FAX (504) 752-4878

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DAVID M. COLEMAN, MS

REGISTERED PROFESSIONAL ENGINEERS

VERNON C. ASHWORTH, MS  
CERTIFIED PROFESSIONAL GEOLOGIST

KENNETH A. FLUKER, MSCE  
DANIEL L. FRANKLIN, JR. MSCE

October 24, 1994

Mr. Ara Arman  
Woodward-Clyde Consultants  
P. O. Box 66317  
Baton Rouge, Louisiana 70896

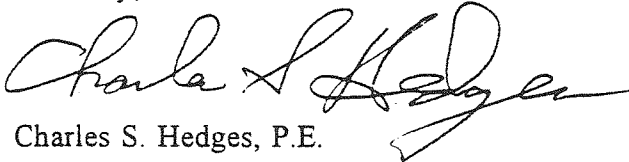
Re: LIGO Chemical Tests  
STE File: 94-1666

Dear Mr. Arman:

Attached are the chemical test data performed for sulfates, sulfides and chlorides. The soil samples tested were the LIGO composite samples provided by Woodward-Clyde.

If there are any questions please call me.

Sincerely,



Charles S. Hedges, P.E.

CSH/slh

# Benchmark Laboratories, Inc.

October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

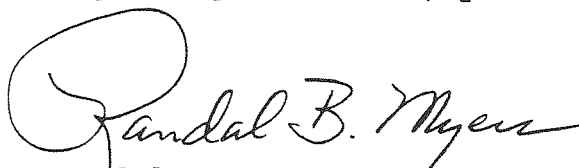
Sample I.D. AA27664                      Location code: STE\_BR  
Location Description: Sample #1 (94-1666)  
Sample collector: CLIENT  
Lab submittal date: 10/10/94              Time: 11:45  
Received by: JLS                              Validated by: CLB

Parameter: Sulfates(as SO4) (Turbidimetirc)  
Method reference: EPA 375.4  
Result: 434 mg/Kg                              MDL or sensitivity: 10  
Date started: 10/18/94                      Date finished: 10/18/94  
Time started: 14:30                              Analyst: LHD

Parameter: Sulfide  
Method reference: SW-846/9030  
Result: 118 mg/Kg                              MDL or sensitivity: 2.5  
Date started: 10/14/94                      Date finished: 10/14/94  
Time started: 15:00                              Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)  
Method reference: SM 4500 CL-D  
Result: 241 mg/Kg                              MDL or sensitivity: 2.5  
Date started: 10/18/94                      Date finished: 10/18/94  
Time started: 14:00                              Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager

# Benchmark Laboratories, Inc.

October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

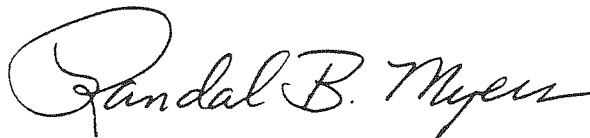
Sample I.D. AA27665	Location code: STE_BR
Location Description: Sample #2 (94-1666)	
Sample collector: CLIENT	Sample collection date: 10/10/94
Lab submittal date: 10/10/94	Time: 11:45
Received by: JLS	Validated by: CLB

Parameter: Sulfates(as SO <sub>4</sub> ) (Turbidimetirc)	
Method reference: EPA 375.4	
Result: 1240 mg/Kg	MDL or sensitivity: 10
Date started: 10/18/94	Date finished: 10/18/94
Time started: 14:30	Analyst: LHD

Parameter: Sulfide	
Method reference: SW-846/9030	
Result: 33.8 mg/Kg	MDL or sensitivity: 2.5
Date started: 10/14/94	Date finished: 10/14/94
Time started: 15:00	Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)	
Method reference: SM 4500 CL-D	
Result: 586 mg/Kg	MDL or sensitivity: 2.5
Date started: 10/18/94	Date finished: 10/18/94
Time started: 14:00	Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager



# Benchmark Laboratories, Inc.

October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

Sample I.D. AA27666	Location code: STE_BR
Location Description: Sample #3 (94-1666)	
Sample collector: CLIENT	Sample collection date: 10/10/94
Lab submittal date: 10/10/94	Time: 11:45
Received by: JLS	Validated by: CLB

Parameter: Sulfates(as SO4) (Turbidimetirc)

Method reference: EPA 375.4

Result: 1240 mg/Kg

Date started: 10/18/94

Time started: 14:30

MDL or sensitivity: 10

Date finished: 10/18/94

Analyst: LHD

Parameter: Sulfide

Method reference: SW-846/9030

Result: 192 mg/Kg

Date started: 10/14/94

Time started: 15:00

MDL or sensitivity: 2.5

Date finished: 10/14/94

Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)

Method reference: SM 4500 CL-D

Result: 214 mg/Kg

Date started: 10/18/94

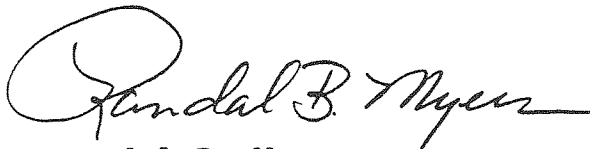
Time started: 14:00

MDL or sensitivity: 2.5

Date finished: 10/18/94

Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager

# BENCHMARK LABORATORIES, INC.

## QUALITY ASSURANCE/QUALITY CONTROL

### BATCH SAMPLE

Client: STE-BR

### DUPLICATES

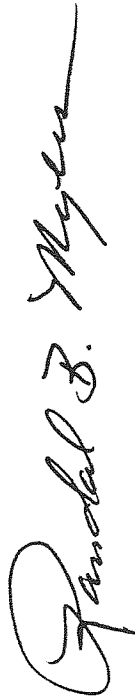
TEST	DATE	UNITS	SAMPLE	DUPLICATE	% DIFF. *	LOW LEVEL**	QA/QC LIMITS	HIGH LEVEL†
Cl	10/18/94	mg/Kg	4.27	4.31	<1	25%	(+/-)	10%
SO <sub>4</sub>	10/18/94	mg/Kg	1240	1240	<1			

NO STANDARD ADDITIONS WERE MADE AND NO SPIKES WERE USED.

### SPIKES

TEST	DATE	UNITS	SAMPLE RESULT	SPIKE AMOUNT	SPIKE RESULT	% RECOVERY	QA/QC LIMITS
Cl	10/18/94	mg/Kg	4.27	25.0	29.3	100	80 - 120%
SO <sub>4</sub>	10/18/94	mg/Kg	25.4	5.00	29.5	82	

\* Additions calculated as % of the known addition recovered, duplicates calculated as the difference as a percentage of the mean (100% ± x%).  
 \*\* Low-level refers to concentrations less than 20 times the MDL. High-level refers to concentrations greater than 20 times the MDL.  
 † Also acceptance limits for independent laboratory control standards and certification of operation competence.



# Benchmark Laboratories, Inc.

October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

Sample I.D. AA27666	Location code: STE_BR
Location Description: Sample #3 (94-1666)	Sample collection date: 10/10/94
Sample collector: CLIENT	Time: 11:45
Lab submittal date: 10/10/94	Validated by: CLB
Received by: JLS	

Parameter: Sulfates (as SO<sub>4</sub>) (Turbidimetric)  
Method reference: EPA 375.4  
Result: 1240 mg/Kg  
Date started: 10/18/94  
Time started: 14:30

MDL or sensitivity: 10  
Date finished: 10/18/94  
Analyst: LHD

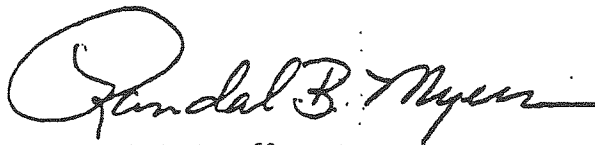
Parameter: Sulfide  
Method reference: SW-846/9030  
Result: 192 mg/Kg  
Date started: 10/14/94  
Time started: 15:00

MDL or sensitivity: 2.5  
Date finished: 10/14/94  
Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)  
Method reference: SM 4500 CL-D  
Result: 214 mg/Kg  
Date started: 10/18/94  
Time started: 14:00

MDL or sensitivity: 2.5  
Date finished: 10/18/94  
Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager

# Benchmark Laboratories, Inc.

October 20, 1994

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316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

Sample I.D. AA27665  
Location Description: Sample #2 (94-1666)  
Sample collector: CLIENT  
Lab submittal date: 10/10/94  
Received by: JLS

Location code: STE\_BR  
Sample collection date: 10/10/94  
Time: 11:45  
Validated by: CLB

Parameter: Sulfates (as SO<sub>4</sub>) (Turbidimetric)  
Method reference: EPA 375.4  
Result: 1240 mg/Kg  
Date started: 10/18/94  
Time started: 14:30

MDL or sensitivity: 10  
Date finished: 10/18/94  
Analyst: LHD

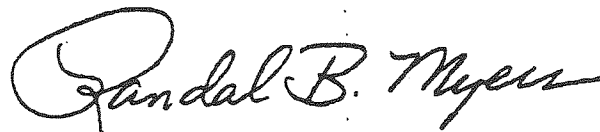
Parameter: Sulfide  
Method reference: SW-846/9030  
Result: 33.8 mg/Kg  
Date started: 10/14/94  
Time started: 15:00

MDL or sensitivity: 2.5  
Date finished: 10/14/94  
Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)  
Method reference: SM 4500 CL-D  
Result: 586 mg/Kg  
Date started: 10/18/94  
Time started: 14:00

MDL or sensitivity: 2.5  
Date finished: 10/18/94  
Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager

# Benchmark Laboratories, Inc.

October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

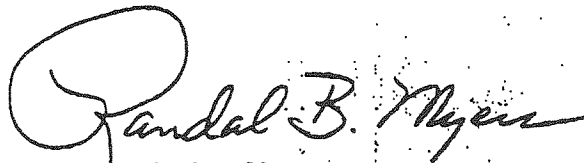
Sample I.D. AA27664                      Location code: STE\_BR  
Location Description: Sample #1 (94-1666)  
Sample collector: CLIENT  
Lab submittal date: 10/10/94              Time: 11:45  
Received by: JLS                              Validated by: CLB

Parameter: Sulfates (as SO<sub>4</sub>) (Turbidimetric)  
Method reference: EPA 375.4  
Result: 434 mg/Kg                              MDL or sensitivity: 10  
Date started: 10/18/94                      Date finished: 10/18/94  
Time started: 14:30                              Analyst: LHD

Parameter: Sulfide  
Method reference: SW-846/9030  
Result: 118 mg/Kg                              MDL or sensitivity: 2.5  
Date started: 10/14/94                      Date finished: 10/14/94  
Time started: 15:00                              Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)  
Method reference: SM 4500 CL-D  
Result: 241 mg/Kg                              MDL or sensitivity: 2.5  
Date started: 10/18/94                      Date finished: 10/18/94  
Time started: 14:00                              Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager

# BENCHMARK LABORATORIES, INC.

## QUALITY ASSURANCE/QUALITY CONTROL

### BATCH SAMPLE

Client: **STE-BR**

#### DUPLICATES

<u>TEST</u>	<u>DATE</u>	<u>UNITS</u>	<u>SAMPLE</u>	<u>DUPLICATE</u>	<u>\$ DIFF.*</u>	<u>LOW LEVEL**</u>	<u>QA/QC LIMITS</u>
CL	10/18/94	mg/kg	4.27	4.31	<1	25% (+/-)	10%
SO <sub>4</sub>	10/18/94	mg/kg	1240	1240	<1		HIGH LEVEL†

NO STANDARD ADDITIONS WERE MADE AND NO SPIKES WERE USED.

#### SPIKES

<u>TEST</u>	<u>DATE</u>	<u>UNITS</u>	<u>SAMPLE RESULT</u>	<u>SPIKE AMOUNT</u>	<u>SPIKE RESULT</u>	<u>\$ RECOVERY</u>	<u>QA/QC LIMITS</u>
CL	10/18/94	mg/kg	4.27	25.0	29.3	100	80 - 120%
SO <sub>4</sub>	10/18/94	mg/kg	25.4	5.00	29.5	82	

\* Additions calculated as % of the known addition recovered, duplicates calculated as the difference as a percentage of the mean [(100%)-1]d.  
 \*\* Low-level refers to concentrations less than 20 times the MDL. High-level refers to concentrations greater than 20 times the MDL.  
 † Also compares data for independent laboratory control standards and certification of operation competence.

*Arnold B. Myler*

# Benchmark Laboratories, Inc.

October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

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Sample collector: CLIENT	Time: 11:45
Lab submittal date: 10/10/94	Validated by: CLB
Received by: JLS	

Parameter: Sulfates (as SO<sub>4</sub>) (Turbidimetric)  
Method reference: EPA 375.4  
Result: 1240 mg/Kg  
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Time started: 14:30

MDL or sensitivity: 10  
Date finished: 10/18/94  
Analyst: LHD

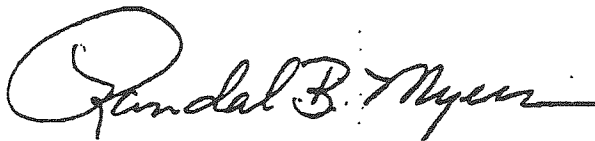
Parameter: Sulfide  
Method reference: SW-846/9030  
Result: 192 mg/Kg  
Date started: 10/14/94  
Time started: 15:00

MDL or sensitivity: 2.5  
Date finished: 10/14/94  
Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)  
Method reference: SM 4500 CL-D  
Result: 214 mg/Kg  
Date started: 10/18/94  
Time started: 14:00

MDL or sensitivity: 2.5  
Date finished: 10/18/94  
Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager





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October 20, 1994

To: Soil Testing Engineers, Inc.  
316 Highlandia Drive  
Baton Rouge, LA 70810

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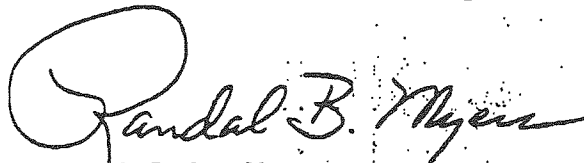
Sample I.D. AA27664                      Location code: STE\_BR  
Location Description: Sample #1 (94-1666)  
Sample collector: CLIENT  
Lab submittal date: 10/10/94              Time: 11:45  
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Result: 434 mg/Kg                              MDL or sensitivity: 10  
Date started: 10/18/94                      Date finished: 10/18/94  
Time started: 14:30                              Analyst: LHD

Parameter: Sulfide  
Method reference: SW-846/9030  
Result: 118 mg/Kg                              MDL or sensitivity: 2.5  
Date started: 10/14/94                      Date finished: 10/14/94  
Time started: 15:00                              Analyst: LHD

Parameter: Chlorides (Specific Ion Probe)  
Method reference: SM 4500 CL-D  
Result: 241 mg/Kg                              MDL or sensitivity: 2.5  
Date started: 10/18/94                      Date finished: 10/18/94  
Time started: 14:00                              Analyst: LHD

If there are any questions regarding this data, please call.



Randal B. Myers  
Laboratory Manager

# BENCHMARK LABORATORIES, INC.

## QUALITY ASSURANCE/QUALITY CONTROL

### BATCH SAMPLE

Client: STE-BR

#### DUPLICATES

TEST	DATE	UNITS	SAMPLE	DUPLICATE	% DIFF. ±	LOW LEVEL**	QA/OC LIMITS HIGH LEVEL†
Cl	10/18/94	mg/Kg	4.27	4.31	<1	25%	(+/-) 10%
SO <sub>4</sub>	10/18/94	mg/Kg	1240	1240	<1		

NO STANDARD ADDITIONS WERE MADE AND NO SPIKES WERE USED.

#### SPIKES

TEST	DATE	UNITS	SAMPLE RESULT	SPIKE AMOUNT	SPIKE RESULT	% RECOVERY	QA/OC LIMITS
Cl	10/18/94	mg/Kg	4.27	25.0	29.3	100	80 - 120%
SO <sub>4</sub>	10/18/94	mg/Kg	25.4	5.00	29.5	82	

\* Addition calculated as % of the known addition recovered, duplicate calculated as the difference as a percentage of the mean (NIST-171a)  
 \*\* Low-level refers to concentrations less than 20 times the MDL. High-level refers to concentrations greater than 20 times the MDL.  
 † Also compares limits for independent laboratory control standards and certification of operation competence.

*Randall B. Myers*

**LIGO/ Cal. Tech Project  
Livingston Parish, Louisiana  
for  
Woodward-Clyde Consultants  
Baton Rouge, Louisiana**

**Soil Sample Laboratory Resistivity and pH  
Test Results**

Composite Sample No.	Test No.	pH Content %	Moisture Content %	Test Reading ohms	Resistivity ohm-cm	Notes
1	Tan silty fine sand with small gravel					
	R <sub>1</sub>	6.68	16.1 (N)	13,000	89,700	
	R <sub>2</sub>		21.4	27,500	189,750	
	R <sub>3</sub>		27.5	8000	55,200	
	R <sub>4</sub>		33.1	3000	20,700	
	R <sub>5</sub>		39.9	3000	20,700	
2	Light gray slightly silty clay					
	R <sub>6</sub>	6.98	24.5 (N)	3500	24,150	
	R <sub>7</sub>		35.7	15,000	103,500	
	R <sub>8</sub>		44.5	20,000	138,000	
	R <sub>9</sub>		56.9	4,000	27,600	
	R <sub>10</sub>		76.2	13,000 5,000	89,700 34,500	(3)
3	Light gray and tan silty clay					
	R <sub>11</sub>	6.52	15.8 (N)	3000	20,700	
	R <sub>12</sub>		19.0	4000	27,600	
	R <sub>13</sub>		22.9	4000	27,600	

**NOTES:**

- 1) N is natural moisture content of sample as received
- 2) Soil box factor (SBF) = 6.90 cm
- 3) First reading after 6 hour "cure." Second reading after 50 hour "cure." The high readings for R<sub>7</sub> and R<sub>8</sub>, which had 6 hour cure, were apparently due to dielectric influence of the distilled water without of sufficient cure-time of allow "dissolution" and equilibrium of conductive clay minerals or chemical electrolyte salts.

**LIGO/ Cal. Tech Project  
Livingston Parish, Louisiana  
for  
Woodward-Clyde Consultants  
Baton Rouge, Louisiana**

**Soil Sample Laboratory Resistivity and pH  
Test Results**

Composite Sample No.	Test No.	pH Content %	Moisture Content %	Test Reading ohms	Resistivity ohm-cm	Notes
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	R <sub>4</sub>		33.1	3000	20,700	
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2	Light gray slightly silty clay					
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	R <sub>8</sub>		44.5	20,000	138,000	
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**LIGO/ Cal. Tech Project  
Livingston Parish, Louisiana  
for  
Woodward-Clyde Consultants  
Baton Rouge, Louisiana**

**Soil Sample Laboratory Resistivity and pH  
Test Results**

Composite Sample No.	Test No.	pH Content %	Moisture Content %	Test Reading ohms	Resistivity ohm-cm	Notes
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	R <sub>4</sub>		33.1	3000	20,700	
	R <sub>5</sub>		39.9	3000	20,700	
2	Light gray slightly silty clay					
	R <sub>6</sub>	6.98	24.5 (N)	3500	24,150	
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	R <sub>10</sub>		76.2	13,000 5,000	89,700 34,500	(3)
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	R <sub>12</sub>		19.0	4000	27,600	
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**LIGO/ Cal. Tech Project  
Livingston Parish, Louisiana  
for  
Woodward-Clyde Consultants  
Baton Rouge, Louisiana**

**Soil Sample Laboratory Resistivity and pH  
Test Results**

Composite Sample No.	Test No.	pH Content %	Moisture Content %	Test Reading ohms	Resistivity ohm-cm	Notes
1	Tan silty fine sand with small gravel					
	R <sub>1</sub>	6.68	16.1 (N)	13,000	89,700	
	R <sub>2</sub>		21.4	27,500	189,750	
	R <sub>3</sub>		27.5	8000	55,200	
	R <sub>4</sub>		33.1	3000	20,700	
	R <sub>5</sub>		39.9	3000	20,700	
2	Light gray slightly silty clay					
	R <sub>6</sub>	6.98	24.5 (N)	3500	24,150	
	R <sub>7</sub>		35.7	15,000	103,500	
	R <sub>8</sub>		44.5	20,000	138,000	
	R <sub>9</sub>		56.9	4,000	27,600	
	R <sub>10</sub>		76.2	13,000 5,000	89,700 34,500	(3)
3	Light gray and tan silty clay					
	R <sub>11</sub>	6.52	15.8 (N)	3000	20,700	
	R <sub>12</sub>		19.0	4000	27,600	
	R <sub>13</sub>		22.9	4000	27,600	

**NOTES:**

- 1) N is natural moisture content of sample as received
- 2) Soil box factor (SBF) = 6.90 cm
- 3) First reading after 6 hour "cure." Second reading after 50 hour "cure." The high readings for R<sub>7</sub> and R<sub>8</sub>, which had 6 hour cure, were apparently due to dielectric influence of the distilled water without of sufficient cure-time of allow "dissolution" and equilibrium of conductive clay minerals or chemical electrolyte salts.

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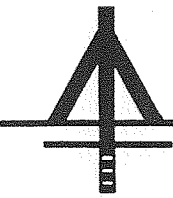
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**RESISTIVITY TEST RESULTS**



# STE

Soil Testing Engineers, Inc.

316 HIGHLANDIA DRIVE • P.O. BOX 83710 • BATON ROUGE, LOUISIANA 70884  
TELEPHONE (504) 752-4790 • FAX (504) 752-4878

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October 24, 1994

Mr. Ara Arman  
Woodward-Clyde Consultants  
P. O. Box 66317  
Baton Rouge, Louisiana 70896

Re: LIGO Resistivity Tests  
STE File: 94-1666

Dear Mr. Arman:

Attached is a data table of the resistivity soil test box determinations. The soil samples tested were the LIGO composite samples provided by Woodward-Clyde.

The tests were performed in accordance with the Texas DOT TEX-129-E (1986) and the LA DOTD TR 429-77 procedures.

The Sample 1 and Sample 2 test data shows a variation or "sharp" rise for the first tests ( $R_2$ ,  $R_7$ , and  $R_8$ ) after tested at initial/natural moisture content. I have reviewed the tests, the test method and resistivity technical literature. It appears that the resistivity rise is due, in part, to the dielectric effect of the distilled water used for the test.

The initial/natural moisture content (tests  $R_1$ ,  $R_6$ , and  $R_{12}$ ) are usable for in-situ conditions. The final tests values (tests  $R_5$ ,  $R_{10}$ , and  $R_{13}$ ) are applicable for flooded conditions.

The tests are applicable for natural effects but, probably not applicable for electrical, electromagnetic conditions, or static grounding conditions.

If there are any questions please call me.

Sincerely,

Charles S. Hedges, P.E.



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**RESISTIVITY V.S. CORROSION TABLE E-2**

TABLE E-2

## RESISTIVITY VS. CORROSION POTENTIAL

Specific Conductivity, cm/ohm	Specific Resistivity, cm/ohm	Expected Corrosion Attack
> 10 <sup>-3</sup>	< 1,000	very strongly aggressive
10 <sup>-3</sup> - 3.3 x 10 <sup>-4</sup>	1,000 - 3,000	strongly aggressive
3.3 x 10 <sup>-4</sup> - 2 x 10 <sup>-4</sup>	3,000 - 5,000	aggressive
2 x 10 <sup>-4</sup> - 10 <sup>-4</sup>	5,000 - 10,000	moderately aggressive
10 <sup>-4</sup> - 5 x 10 <sup>-5</sup>	10,000 - 20,000	slightly aggressive
< 10 <sup>-5</sup>	> 20,000	virtually nonaggressive

**TEST METHOD FOR RESISTIVITY**

## State Department of Highways and Public Transportation

## Materials and Tests Division

## METHOD OF TEST FOR THE RESISTIVITY OF SOILS MATERIAL

## Scope

This test method outlines the procedure for obtaining the resistivity of soil and aggregate materials. Resistivity (ohm-cm) varies directly with the moisture content of the material until the minimum resistivity is obtained. This minimum resistivity value is defined as the resistivity of the material. Resistivity is an important factor in considering the use of metal pipe, earth-reinforcing strips and other metal items in earthwork.

## Sample

Secure a representative sample of the total material of sufficient size to yield approximately 1300 grams of material passing the No. 8 mesh sieve. Test Method Tex-100-E should be followed in sizing and selecting a representative size.

## Apparatus

1. Portable resistivity meter. Vibroground Model 293 or equal.
2. Small box with inside dimensions of 4 inches x 6 inches x 1-3/4 inches (see Figure 2).
3. Straightedge.
4. Drying pans, mixing pans, trowel and small scoop.
5. A No. 8 Standard U.S. Sieve meeting the requirements of Test Method Tex-907-K.
6. 200 ml graduated beaker.
7. A balance with a minimum capacity of 1500 grams which meets the requirements of Test Method Tex-901-K, Class II-D.
8. See Figure 1 for equipment set-up.

## Materials

Distilled or demineralized water.

## Procedure

1. Select a representative sample of the material to be tested for resistivity.
2. Dry the sample to constant weight in an oven at a temperature of  $140^{\circ} \pm 9^{\circ}\text{F}$  and allow to cool at room temperature.
3. Soils that form hard lumps or contain aggregates will be crushed to pass the No. 8 sieve.

4. The sample will be reduced by a sample splitter or quartering cloth to make a soil sample of approximately 1300 grams. Weigh sample to nearest 0.5 gram.

5. Place the wires from one clip on the left of the meter dial and the wires from the other clip on the right.

6. Fill the soil box with the well-mixed dry soil, compact lightly with fingers and level off the top with a straightedge. Connect the resistivity meter to the side terminals of the box. Place switch in Adj. position during preliminary adjustments. For maximum sensitivity place the switch in Read position. Read and record the resistance, in ohms, on the data sheet (page 3).

7. Empty the soil back into the mixing pan and add 100 ml of distilled or demineralized water at room temperature and mix until all the water is dispersed uniformly through the soil. Fill the soil box by lightly hand-compacting the wet soil, making sure that the soil completely fills the box. Level off the top of the hand-compacted sample with a straightedge. Connect the resistivity meter to the box (as in Step 6). Read and record the resistance on the data sheet.

8. Repeat the above procedure, using the same sample, adding distilled or demineralized water in increments of 50 ml for sandy soils and 100 ml for clayey soils. Insure that each addition of water is dispersed evenly through the sample. The resistivity readings should decrease for several readings before an increase is noted. The lowest resistivity reading before an increase will be the reading to use for calculating the resistivity of the soil, as shown on the data sheet (page 3). The resistivity for sandy soils is generally higher than for clayey soils. The sandy soils may contain higher levels of soluble salts and not always increase after several decreasing readings. For sandy soils the reading used to calculate the resistivity value will be when total saturation occurs. This is when water is observed rising to the surface during compaction of the sample.

## Calculations

$$\begin{aligned} \text{Resistivity (in ohm-cm)} &= \text{Box Factor} \times \text{Resistance.} \\ \text{Soil Box Factor} &= \frac{A}{D} \text{ cm} \end{aligned}$$

$$\begin{aligned} A &= \text{Area of one electrode} \\ D &= \text{Distance between electrodes} \end{aligned}$$

$$\text{S.B.F.} = \frac{6' \times 1.75' \times 2.54 \text{ in.}}{4'}$$

$$\text{S.B.F.} = 6.67 \text{ cm}$$

NOTES:

1. The dial reading is resistance in ohms and is measured between the two electrodes that are separated by 4 inches of soil in this procedure.

2. Resistivity varies with temperature; therefore, it is important that the soil and added moisture be at uniform room temperature when mixed and tested.

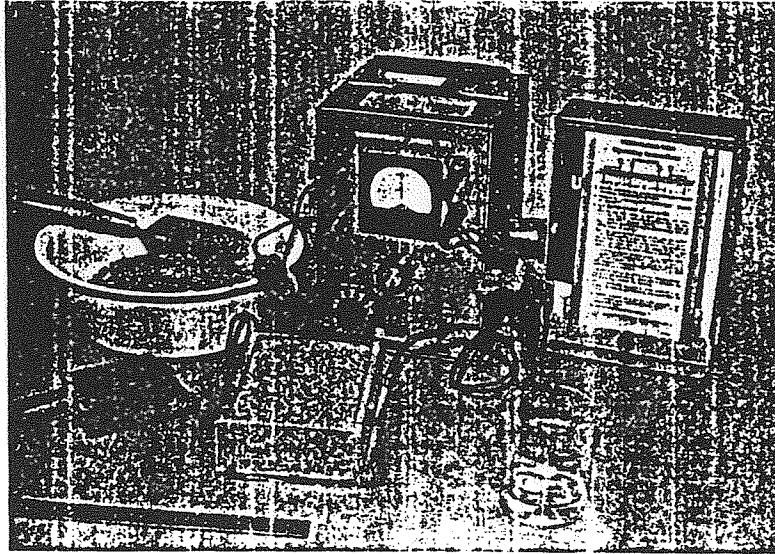


Figure 1



Project: \_\_\_\_\_

Date: \_\_\_\_\_

Location: \_\_\_\_\_

By: \_\_\_\_\_

Soil Type: \_\_\_\_\_

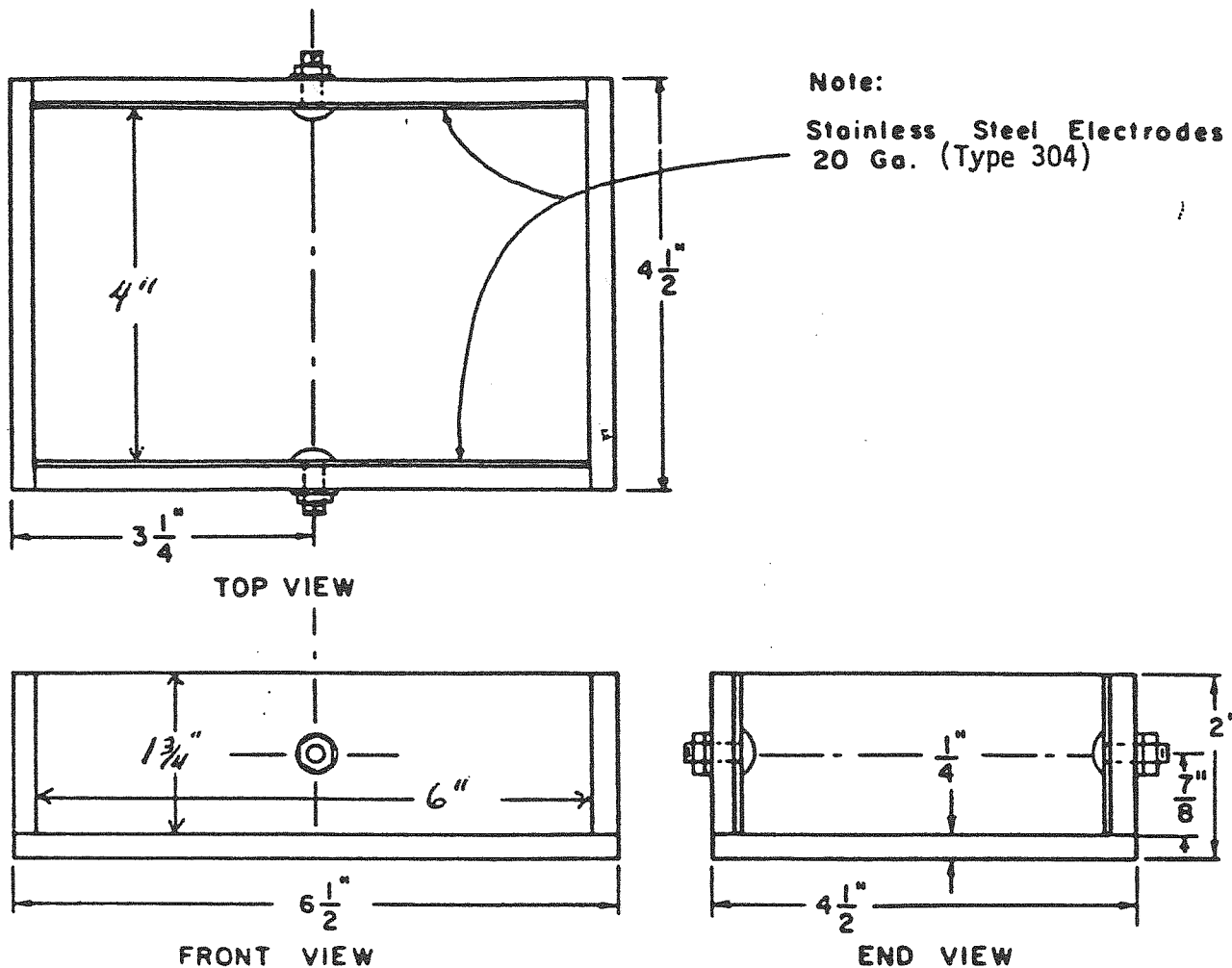
Laboratory Number	Location	Depth (ft)	Weight Soil (g)	Water Added (ml)	Multiplier	Dial Reading	Resistance (ohms)
Example #1	SH 000	3-6	1300	0	10 <sup>4</sup>	1.0	10000
				150	10 <sup>4</sup>	1.0	10000
				150	10 <sup>4</sup>	.57	5700
				150	10 <sup>4</sup>	.33	3300
				150	10 <sup>4</sup>	.23	2300*
				150	10 <sup>4</sup>	.24	2400

\*Minimum resistance reading

Resistivity (ohm-cm) = Box Factor X Resistance

$$R = 6.67 \times 2300^*$$

$$R = 15,341 \text{ ohm-cm}$$



Soil Box For Laboratory Resistivity Determination

**Material: 1/4" Plastic**

Bottom - 1 Pc. 6 1/2" x 4 1/2" x 1/4"

Ends - 2 Pcs. 4 1/2" x 1 3/4" x 1/4"

Sides - 2 Pcs. 6" x 1 3/4" x 1/4"

Electrode - 2 Pcs. 20 Ga. Stainless Steel 6" x 1 3/4"

2 Ea. No. 8-32 x 3/4" Round Head Stainless Steel or Brass Machine Screw with Rubber Washer and Stainless Steel or Brass Washer and Nut.

Figure 2