Blue Ribbon Commission on Bayou Corne and Grand Bayou Public Safety

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| BRC Task ID | GAS-04 |
| Version | Draft 1 |
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# RRD-GAS-02

# SINKHOLE WATER QUALITY DEPTH PROFILE SAMPLING

SEVENTH AMEND. EMERGENCY DEC.
EXHIBIT "A"

# RECOMMENDED REQUIREMENTS DOCUMENT

***Subject:*** **Sinkhole Water Quality Depth Profile Sampling**

## 1.0 Background

The Blue Ribbon Commission (BRC) Gas Group recommends that reducing and maintaining methane gas formation pressures in the Mississippi River Alluvial Aquifer (MRAA) to equal to hydrostatic pressure across the Bayou Corne gas area as one metric necessary in order to lift the mandatory evacuation order. This Recommended Requirements Document (RRD) defines the technical requirements for obtaining sinkhole depth profile water quality data needed to address this overall objective. The intent of this RRD is to provide recommended requirements for use by the appropriate state agencies when directing the development of a comprehensive work plan for addressing the RRD objective.

This RRD for collecting sinkhole water quality depth profile data has been prepared with consideration of the following site conditions and data requirements:

- Since the formation of the sinkhole, natural gas and crude oil have been percolating up from depth and into the sinkhole waters. During periodic sinkhole "burps" where the amount of gas migration to the surface appears to increase, trees and other debris float to the surface for a short period of time, and the amount of crude oil on the surface of the sinkhole also typically increases.
- The available water quality data from the sinkhole illustrate that there is a substantial degradation of water quality from the surface to the 100-foot water depth in the sinkhole with total dissolved solids concentration increasing from approximately 5,000 mg/L at the surface to over 50,000 mg/L at a depth of 100 feet (Hecox and Saxton, 2013).
- Establishing a more complete chemical profile of the sinkhole water quality including dissolved gas concentration will provide a more defined picture of the water column in the sinkhole and will help to determine if the water column contains distinct layers or if there is a chemical gradient throughout the water column.
- The potential exists that reducing conditions in the bottom of the sinkhole are conducive to microbial degradation of sulfate in the presence of methane is producing hydrogen sulfide in the deeper portions of the sinkhole. This sampling will determine if this is occurring and quantify hydrogen sulfide concentrations, if any.
- Data collected from monthly sampling will be used to monitor changes in the sinkhole water quality and how sinkhole events, such as the periodic "burps" or subsidence events, affect the chemical composition of the sinkhole waters.

This RRD has been prepared as part of the overall GAS-04 BRC task. This BRC task addresses the need for chemical constituent concentration data in the sinkhole water for use in quantitative evaluations of gas migration and mitigation. The quantitative evaluation requirements are addressed in other RRDs. This RRD establishes the procedures and equipment required to collect these data.

## 2.0 Objective and Requirements

The objective of this RRD is to quantify and monitor the inorganic and organic chemical constituents and concentrations in the sinkhole for the entire water column from the water surface to the bottom of the sinkhole. The specific laboratory and testing programs shall be specified in the work plan addressing this RRD.

## 3.0 Requirements

The requirements of this RRD for sinkhole water quality depth profile data are:

1. Conduct monthly sinkhole depth-profile water and dissolved gas sampling of the water column from the surface to the bottom of the sinkhole. Due to ongoing changes in the sinkhole configuration, the location of the deepest portion may change over time. As such, the location of the deepest portion for a given sampling event will be determined by the results of the most current bottom survey conducted prior to each sampling event.
2. Field water quality parameters shall be measured and include pressure, specific conductance, temperature, pH, dissolved oxygen (DO), turbidity, and oxidation-reduction potential (ORP).
3. Water samples shall be collected at the water surface and at 25-foot depth intervals down to the bottom of the sinkhole.
4. Water and dissolved gas samples should be analyzed for parameters in **Table 1**. As data are obtained, this parameter list can be adjusted. Both total and dissolved (0.45 $\mu$ filter) metals shall be analyzed.

**Table 1. Sinkhole Water Quality Laboratory Analyte List**

| Gas Analysis | Trace Metals | Major Ions and General Parameters | Organic Compounds |
|---|---|---|---|
| Argon | Aluminum | Total Alkalinity (as CaCO3) | Total Petroleum Hydrocarbons, GRO |
| Butane | Antimony | Alkalinity, Bicarbonate (as CaCO3) | Total Petroleum Hydrocarbons, DRO |
| Carbon Dioxide | Arsenic | Alkalinity, Carbonate (as CaCO3) | Aliphatic C6-C8 |
| del 13C1 | Barium | Calcium | Aliphatic >C8-C10 |
| del 13C2 | Beryllium | Chloride | Aliphatic >C10-C12 |
| del 13C3 | Boron | Magnesium | Aliphatic >C12-C16 |
| del 13IC4 | Bromide | Potassium | Aliphatic >C16-C35 |
| del 13NC4 | Cadmium | Sodium | Aromatic >C8-C10 |
| del Dc1 | Chromium, Total | Sulfate (as SO4) | Aromatic >C10-C12 |
| Ethane | Cobalt | Total Dissolved Solids (Residue, Filterable) | Aromatic >C12-C16 |
| Ethene | Copper | Total Suspended Solids | Aromatic >C16-C21 |
| Helium | Iron | Water Density | Aromatic >C21-C35 |
| Hexanes + heavier | Lead | | Benzene |
| Hydrogen | Lithium | | Ethylbenzene |
| hydrogen Sulfide | Manganese | | Toluene |
| Isobutane | Mercury | | Xylene, total |
| Isopentane | Nickel | | |
| Methane | Selenium | | |
| Nitrogen | Silver | | |
| Oxygen | Strontium | | |
| Pentane | Thallium | | |
| Propane | Vanadium | | |
| Propene | Zinc | | |
| Specific Gravity | | | |

**Appendix 1** presents suggested procedures for data collection to meet the above objective and requirements. These procedures can be modified or replaced as appropriate to meet the objectives and requirements.

# APPENDIX 1
# SUGGESTED PROCEDURES

# *1.0 Introduction*

This appendix is intended for use as a procedural reference for obtaining the data required in the RRD. The procedures in this section have been used by one or more Blue Ribbon Commissioners to obtain or generate the data specified in Section 3.0 of the RRD. In preparing the work plan to address this RRD, other procedures can be used provided the objectives and data requirements in Sections 2 and 3 are met.

# *2.0 Contract Services*

## *2.1 Isotech Laboratories, Inc.*

Water samples submitted for compositional gas analysis and isotopes should be submitted to Isotech Laboratories, Inc. in Champaign, Illinois or an equivalent laboratory specializing in analysis of dissolved gases.

## *2.2 Louisiana Accredited Analytical Laboratory*

With the exception of samples submitted for compositional gas analysis and isotopes, all other samples submitted for laboratory analysis should be analyzed by a laboratory accredited under the Louisiana Department of Environmental Quality's (LDEQ) Louisiana Environmental Laboratory Accreditation Program (LELAP).

# *3.0 Specialized Field Equipment*

## *3.1 Boat Equipped with a Sample Winch/Depth Meter*

The sampling boat shall be equipped with a manual or electric sample winch with the cable marked in feet or an attached depth counter. The winch should have a minimum of 300 feet of cable. A second supply boat is recommended for handling decontamination activities and storage of sample coolers, sample containers, and sampling supplies.

## *3.2 Tag Line*

A tag line, with a minimum of 500 feet of line weighted at the end and marked in feet and tenths of feet or equivalent, should be provided for depth measurements.

## *3.3 In-Situ Troll® 9500 and Rugged Reader®*

The In-Situ Troll® 9500 with cable-coupled RDO dissolved oxygen sensor (http://www.in-situ.com/products/water-quality/troll-9500-sensors/rdo-sensors-for-the-troll-9500) and 9500 magnetic stirrer, is a water quality instrument that can measure up to nine (9) water quality parameters which can be recorded and saved on the Rugged Reader®. At a minimum the following water quality parameters should be measured in the sinkhole: pressure, pH, temperature, conductance, DO, ORP, and turbidity. The Troll is programmed and data recorded with a Rugged Reader or smarTROLL iPhone app.

## 3.4 Van Dorn Samplers

Van Dorn-style samplers are recommended to collect samples at various depths of the water column to maintain integrity of the dissolved gases in the water sample. The sampler should have a minimum of 4.2 liter capacity although the 6.2 liter sampler may reduce field time if a properly configured winch is used. A vertical Van Dorn sampler is recommended as this allows for easier dissolved gas sample retrieval. Two Van Dorn samplers are recommended to allow for one to be decontaminated while the other one is being used to collect a sample.

## 3.5 Sample Filtering Equipment

Peristaltic pump and 0.45 micron high-capacity filters and tubing should be provided in sufficient quantity for the number of anticipated samples.

## 3.6 Sampling Supplies

Appropriate sample containers (sufficient quantity for the number of anticipated samples), coolers, labels, chain-of-custody forms, nitrile or latex gloves, and miscellaneous sampling supplies should be provided.

## 3.7 Decontamination Supplies

Appropriate tubs, brushes, decon fluids (distilled or deionized water, Alconox soap or equivalent), brushes, paper towels, and foil should be provided. It is recommended that a decon station be set up on a second boat for this sampling.

## 3.8 GPS Unit

A portable global positioning system (GPS) unit with sub-meter accuracy and real-time tracking capability is recommended.

# 4.0 Definitions

The following definitions are applicable to this appendix:

- *Van Dorn Sampler*—specialized sampling device capable of collecting dissolved gas and water samples at a specific depth.

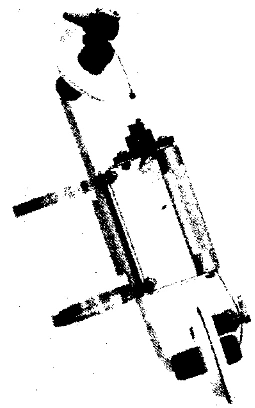


**Figure 1. Vertical Van Dorn sampler**

- *LELAP*— Louisiana Environmental Laboratory Accreditation Program. Laboratory data generated by commercial environmental laboratories that are not accredited under these regulations will not be accepted by the department in accordance with LAC 33:I.4501.A.2. Whenever samples are subcontracted to another environmental testing laboratory, the original laboratory shall maintain a verifiable copy the results with a chain of custody. The procedure may not be used to circumvent proper accreditation or any state requirements. The original laboratory is responsible for ensuring that the secondary laboratory used is properly accredited for the scope of testing performed in accordance with LAC 33:I.5307.D.

# 5.0 Procedure

The following procedures are recommended for the collection of depth-profile water quality samples from the sinkhole. These procedures are based on previous experience with sampling surface water and water at depth along the Louisiana Gulf Coast. The sampling should be conducted using a primary sample boat with a second supply boat for handling decontamination, sample coolers, ice, and bottles.

## 5.1 Sinkhole Access/Seismic Clearance

Before launching the boats, meet with the site seismic monitoring authority to obtain the current Seismic Activity Level Code which will indicate if personnel can enter and perform work on the sinkhole. The depth-profile sampling can only be conducted during periods when the Seismic Activity Level Code is at Level 1/Green. A competent and knowledgeable person should monitor the seismic helicorders when personnel are working on the sinkhole. Cell-phone or OEP radio communications will be used during the sampling.

## 5.2 Route and Sample Location Tracking

Upon leaving the boat launch, turn on the GPS unit in tracking mode and allow it to record the track of the entire sample event. Place the unit in the location where it has a clear signal from the sky, away from any other electronic or magnetic equipment that could cause interference, but is out of the way for sampling. Turn the unit off only after sampling is complete and the boats are back at the dock.

## 5.3 Boat Positioning/Sample Location

Position the sampling boat over the deepest depth location in the sinkhole, based on the most recent depth profiles. Since it may not possible to anchor the boats, procedures for maintaining proper location over the deepest part of the sinkhole should be coordinated with the boat operators.

## 5.4 Depth Gauging

Once the boat has been positioned over the deepest part of the sinkhole, sound the bottom of the sinkhole using the tag line. Record the depth of the sinkhole at this location.

## 5.5 Water Quality Measurements

With the In-Situ, Inc. Troll® 9500, measure pressure, pH, specific conductance, temperature, DO, turbidity, and ORP at 10-foot depth intervals from the water surface down to just above the bottom of the sinkhole. Attach the tag line to the Troll® sensor for measuring the depth—it is not possible to use pressure to determine depth because of the variable density water in the sinkhole. Use the Troll® logging function (In-Situ, Inc. Rugged Reader® required) to continuously record the data and write down the final values at each 10-foot depth interval on the sample collection log. It may take several minutes for the DO and ORP readings to stabilize at a given depth; the magnetic stirrer facilitates stabilization.

## 5.6 Surface Water Sample Collection

Using a peristaltic pump and new, clean Teflon tubing, collect water and dissolved gas samples at approximately 1-foot below the water surface. Place the proper aliquots in the labeled sample bottles. Filter the sample that will be submitted for dissolved metals analysis. Use the Isobag and peristaltic pump for collecting the dissolved gas samples.

## 5.7 Depth Profile Water Sample Collection

Using the Van Dorn sampler (Lane et al., 2003), collect depth profile water samples at depths of 10 feet, 25 feet, 50 feet, and every 25 feet thereafter to the bottom of the sinkhole. The last sample should be approximately 5 feet above the bottom of the sinkhole. As a guide for the final sample, if the bottom of the sinkhole is at 160 feet, it is not necessary to collect a sample at 155 feet and the 150-foot sample will be the bottom sample. If the bottom of the sinkhole is at 165 feet, then the bottom sample will be collected at the 160-foot depth.

It is important that the boat location be maintained close to the deepest portion of the sinkhole during all sampling. It is recommended that the GPS unit be operated in tracking mode to document any changes in boat location during the sampling events.

A water sample at the selected depths should be collected as follows using a Van Dorn sampler which has been properly decontaminated. Any sampling personnel that will come into contact with the sampling device and/or sampling containers shall wear a new, clean pair of nitrile or latex gloves during all sampling activities. The gloves should all be changed in between each sample. Below are the general sampling procedures that are recommended:

1. Confirm that the winch cable is securely attached to the sampling device. Check that the sample valves (located on the sampler end caps) on the Van Dorn sampler are both closed. Set the end cap trigger mechanism as per manufacturer instructions.
2. Using the winch with depth meter on the boat, lower the Van Dorn sampler to the target depth. Make sure that the rope attached to the sampler is free of knots and kinks so that the messenger (weighted cylinder) can reach the sampling device.
3. Upon reaching the desired depth, release the messenger (weighted cylinder) to trigger the closing of the sampler end caps.
4. Retrieve the Van Dorn sampler into the boat using the winch.
5. Hold the sampling device in the vertical position then open the top sample port. **The sampler will be under pressure and so caution must be used when opening the valves.**
6. Open the bottom valve and using the attached sample port and Teflon tubing, fill the dissolved gas Isobag first followed by the VOC vials. As pressure is relieved in the Van Dorn sampler, open the top sample port to allow for water flow out of the bottom port.
7. New Teflon tubing will be used for each new sample depth.
8. After these samples are collected, fill the appropriate bottles including the filtered dissolved metals container. For dissolved metals, it is preferable to connect tubing to the bottom sample port and pump directly from that port, through the filter into the sample bottle.
9. Properly label each sample at the time of collection. At a minimum, the label should contain the following information: Sample I.D., Depth, Date and Time collected, Sampler's name, requested analysis.
10. Except for the Isobags, samples will be placed on ice in coolers immediately following sample collection.
11. The sampler will hold approximately 4 or 6 liters of water. Make repeated trips to the sample depth as necessary to fill all sample bottles.
12. Decontaminate the sampler on the decon boat using the proper materials and procedures. Because there will likely be oil film on the sampler, a mild (phosphate-free) detergent may be necessary for thorough decontamination. Two samplers are recommended so one can be decontaminated while the second on is being used for sampling.

## 5.8 Sample Handling and Shipment

Upon returning to the dock, pack the samples for shipping to the appropriate laboratory. Add ice if necessary/required. Complete the Chain-of-Custody forms. Transport the samples to the laboratory, laboratory courier, or shipper (i.e. Fed-Ex or UPS).

## 5.9 Sample Analysis

The water samples from each sample depth will be submitted to the appropriate laboratories, following proper chain-of-custody procedures, for analyses. The following analyses will be requested:

### 5.9.1 Isotech Laboratories

The Isobags should be submitted to Isotech Laboratories in Champaign, Illinois or equivalent dissolved gas laboratory for analysis of:

- Compositional Gas (see Table 1 for list of components)
- Compound-specific isotope Ratios (see Table 1 for list of isotopes)

### 5.9.2 LELAP Laboratory

The remaining samples from each depth should be submitted to the selected LELAP laboratory for the following analyses:

- Alkalinity by Method 2320 or equivalent
- Benzene, Toluene, Ethylbenzene, Xylene (BTEX) by U.S. Environmental Protection Agency (EPA) Method 8260 or equivalent
- Chloride by Method SM4500 or Method 9056 or equivalent
- Inorganic Anions by Method 9056 or equivalent
- Metals (dissolved and total) – EPA Method 6010 or equivalent (see Table 1 for metals list)
- Specific Conductance by Method SM2510 or equivalent
- Total Dissolved Solids by Method SM2540 or equivalent
- Total Petroleum Hydrocarbons – Gasoline Range Organics/Diesel Range Organics/Oil Range Organics by EPA Method 8015 or equivalent
- Total Petroleum Hydrocarbon fractions (aliphatics >C6–C35, and aromatics >C8–C35) by Massachusetts TPH Method
- Total suspended solids by Method 160.2 or equivalent
- Water density by hydrometer or equivalent

## 5.10 Equipment Decontamination

At the conclusion of the sampling event, all sampling equipment should be thoroughly decontaminated and placed in proper storage pending future sampling. All disposable equipment shall be properly disposed.

## 5.11 Submittal of Data

All field activities should be documented and reported to LDNR in an electronic format and reasonable time frame. Upon receipt, analytical results shall also be submitted to LDNR in PDF and Excel or similar electronic data transfer format.

# 6.0 Attachments

- *Attachment 1*—Isobag fill procedures

# 7.0 Forms

- Daily Field Activity Log
- Chain-of-Custody Document
- Sample Collection Log

# 8.0 References

Hecox, G. R., and Saxton, D. C., 2013, Bayou Corne Sinkhole Status Report to Blue Ribbon Commission, Baton Rouge, LA, CB&I, 121 plus appendices p.:

Lane, S. L., Flanagan, S., and Wilde, F. D., 2003, Chapter A2, Book 9, Selection of Equipment For Water Sampling, Handbooks for Water-Resources Investigations, National Field Manual for the Collection of Water-Quality Data, Reston, VA, U.S. Geological Survey, v. A2, 123 p.:

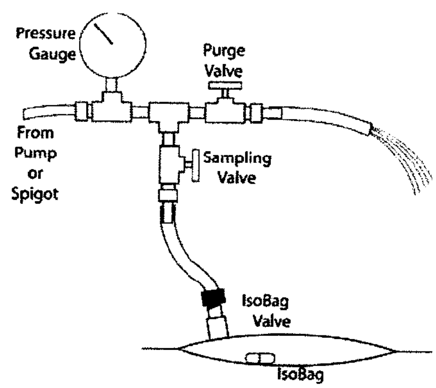
# ATTACHMENT 1

# ISOBAG FILL PROCEDURES

# Collection of Ground Water Samples from Domestic and Municipal Water Wells. for Dissolved Gas Analysis

1. **Sampling source:** Water samples should either be collected from a pressurized water system or by using a suitable water pump. When sampling from a pressurized water system, it is recommended to use an outdoor spigot or other source which bypasses any water treatment systems (i.e. water softeners, etc.). When using a pump, it should be capable of maintaining a constant pressure at or above that which exists within the aquifer. This is to ensure that gases dissolved in the water within the aquifer remain dissolved until the water is transferred into an IsoBag®. If using a pulsating pump such as a bladder pump, please contact Isotech for additional recommendations.

2. **Sampling Mechanism:** After purging the well, a mechanism consisting of a pressure gauge in line with two valves should be attached to the spigot or pump output (see figure). The ***purge valve*** (see figure) allows water to be pumped through the system to purge both the well and the tubing. The ***sampling valve*** (which should point downward), provides a point whereby a sample split can be slowly "bled" off from that water which is being continuously purged out of the system via the ***purge valve***. Sampling in this manner allows for collection of a sample over a longer period of time, and as such should provide a sample that is more representative of the water source, in essence creating an "averaging effect" during collection.




3. **IsoBags:** The gas bags provided have been evacuated in advance. A capsule filled with bactericide has also been inserted.

4. **Collection of samples:** Slowly open the ***purge valve*** to purge any gas or air from the tubing. The flow rate should be controlled so as to allow a reasonable flow, while also maintaining a pressure close to the maximum pressure of the water system or pump. When the line has been adequately purged and a steady state situation is achieved, open the sampling valve slightly to purge the air from it. Then, with the water still running at a low rate, connect the fitting to the valve on the IsoBag and proceed to fill the bag (note: the slower the filling rate, the greater the "averaging effect"). The bag should be filled with approximately 500 cc of water (i.e. to a thickness of about 1 inch). When sufficient sample has been collected, close the sampling valve and quickly disconnect the fitting from the IsoBag. The water flow can now be turned off and the hose disconnected. Reattach the cap to the valve of the IsoBag.

5. **Submission of samples.** After recording the sample identification on the attached label, the bag should be placed in its protective box and packed **laying flat**. Complete a Chain-of-Custody/Analysis Request form and include it with the sample(s). **If possible, samples should be shipped the same day collected, via an overnight delivery service. Client MUST inform Isotech of shipment prior to arrival.** Please note Isotech's receiving hours of **Monday thru Friday** 8:00 am to 4:30 p.m.

   Ship samples to:

   Isotech Laboratories, Inc.
   1308 Parkland Court
   Champaign, IL 61821

**These instructions have been provided to simplify the collection of samples for dissolved gas analysis. Although we try to foresee and avoid problems in the field, it is never possible to predict every situation. If you encounter any difficulties, or if any additions or changes in these instructions would be beneficial, please let us know.**

**Isotech Laboratories, Inc. makes no warranty as to the applicability and/or safety of the procedures described herein.**

**From:** Michael Taylor
**Sent:** Tuesday, July 02, 2013 8:04:38 AM (UTC-06:00) Central Time (US & Canada)
**To:** conservationorder; Gary Snellgrove; Gary Hecox; deborah.saxton@shawgrp.com; John Boudreaux; Travis Williams; brent.cambell@la.gov
**Cc:** Bruce Martin; Mark Cartwright; Troy Charpentier
**Subject:** Fw: Comments on BRC RRD-GAS-002 Sinkhole Water Quality Depth Profile Sampling

Team,

I inadvertently left you off of this email.

Thanks,

mt

Michael Taylor, P.G.; P.E.A.
Grand Bayou Response Manager
901-482-2500

----- Forwarded by Michael Taylor/UNITED on 07/02/2013 08:03 AM -----

From Michael Taylor/UNITED
To "Donald Haydel" <Donald.Haydel@LA.GOV>,
Cc Bruce Martin/UNITED@UNITED, Mark Cartwright/UNITED@UNITED, "Dave Angle" <dangle@mpisani.com>, pritchie@mpisani.com, Maurice Valentine/UNITED, Stella Williams/UNITED@UNITED
Date 07/02/2013 08:02 AM
Subject Comments on BRC RRD-GAS-002 Sinkhole Water Quality Depth Profile Sampling

Don,

I have attached our consultant's (Pisani) comments and questions on the BRC RRD 002 for distribution to the BRC.

After review of the Blue Ribbon Commission (BRC) Recommended Requirements Document pertaining to the sinkhole profiling we provide the following comments.

The scope of work outlined in the BRC document will require MP&A and other field personnel (i.e. air boat, CB&I, etc.) to be located on the sinkhole for a longer period of time, likely an entire day versus approximately 2-3 hours during our current sampling program. To date, we have attempted to minimize the time anyone is on the sinkhole for safety purposes. The BRC proposed monthly sampling can be done but the sampling schedule will still be subject to the Assumption Parish Emergency Response Status Code (i.e. no sampling would be conducted when the Status Code is a 2 or 3).



SEVENTH AMEND. EMERGENCY DEC.
EXHIBIT "B"

We have also noted the following items, some of which will increase the time and number of personnel it will take to complete each sampling event, that will need to be worked out:

1.) Additional equipment will need to be purchased and/or rented (i.e. 500' tag line, Troll 9500 and Rugged Reader, 2 Van Dorn Samplers, Teflon tubing, sub meter accuracy GPS unit)

2.) Who will be the site seismic monitoring authority? Dr. Hecox and/or John Boudreaux, or is Texas Brine's Contractor responsible for this function?

3.) TBC will have Miller Engineering locate the deepest location, either through marking the location with a buoy or a suspended line over the sinkhole with appropriate markers. This would limit the amount of time needed by the sampling team to be located on the sinkhole and provide an anchor/location point for the airboats.

4.) In order to complete the required tasks outlined, it appears that the sampling boat will require at least 2 individuals and the support boat will require 1 individual for decontamination.

5.) It appears that the requested sampling methodology will take a greater amount of time due to the increased parameter list (i.e. more sample bottles required) and decontamination of the sampler.

6.) The attached BRC constituent list has been highlighted to indicate which constituents we are currently analyzing. As this highlighted version demonstrates there are many additional constituents that the BRC is requesting.

7.) Finally, the BRC is requesting monthly profiling events; however, the August, October, and November 2012 and April 2013 sinkhole profiling data we have gathered to date indicate generally similar results (i.e. higher concentrations of chloride and other constituents with depth); therefore, it seems like quarterly data could suffice.

In summary, the extensive BRC sampling program is more suited for a quarterly schedule to limit the amount of time field personnel are located over the sinkhole. However, in consideration of the BRC's monthly sampling request, we propose to conduct two monthly events during Status Code No. 1 time periods and compare the monthly data to the data sets that have been gathered to date. If this data evaluation indicates generally consistent results then we propose to conduct quarterly sampling going forward into the future. We are not certain that collection of monthly data, regardless of what the data would ultimately indicate, would lead to a different long term containment/control response.

We are available to conduct the first monthly profiling event during the end of the week of July 8th, 2013.

Thanks,

mt

Michael Taylor, P.G.; P.E.A.
Grand Bayou Response Manager
901-482-2500

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# RRD-GAS-008A

# EXTENT OF GAS

# SUBSLAB PRESSURE MONITORING

SEVENTH AMEND. EMERGENCY DEC.
EXHIBIT "C"

# RECOMMENDED REQUIREMENTS DOCUMENT

**Subject:** **Subslab Differential Pressure Monitoring**

## *1.0 BACKGROUND*

The Blue Ribbon Commission Gas Group has agreed to recommend that reducing and maintaining methane gas formation pressures in the Mississippi River Alluvial Aquifer (MRAA) to equal to or less than hydrostatic pressure across the Bayou Corne gas area is necessary in order to lift the mandatory evacuation order. This Recommended Requirements Document (RRD) defines the technical requirements for obtaining ORW operational data to address this overall objective. The intent of this RRD is to provide recommended requirements for use by the appropriate state agencies when directing the development of a comprehensive work plan for addressing the RRD objective.

This RRD for collecting subslab pressure monitoring data has been prepared with consideration of the following site conditions:

- There is methane gas bubbling to the surface in the community.
- Shallow well NSDMW15 in the Bayou Corne community consistently has gas pressure sufficient to lift the water out of the well when the wellhead valve is opened.
- The gas in the community has been evaluated and determined to be either thermogenic or a mix of thermogenic and biogenic gas.
- The gas pressure in the MRAA below the community at is at least 58 pounds per square inch (psi).
- Methane has been detected below floor slabs at two locations.

This RRD has been prepared as part of the overall GAS-08 BRC task. This BRC task addresses the extent of the gas in the MRAA and overlying aquitard and the monitoring of the gas for changes over time. This RRD establishes the procedures and equipment required to determine if there is currently gas pressure below the floor slabs in the communities that may require long-term monitoring.

## *2.0 Objective and Scope*

The technical objective of this RRD is to monitor differential pressures between underneath the floor slabs and the occupied spaces of homes or structures.

The geographic scope of this RRD is the slab-on-grad homes and structures in the Grand Bayou and Bayou Corne communities, Assumption Parish, LA. The pressure recording period should be at least one week to allow for a range of barometric changes to be monitored. The number of ports and locations to be monitored must be representative of the overall site conditions in the community.

# APPENDIX 1
# SUGGESTED PROCEDURES

# 1.0 Introduction

This appendix is intended for use as a procedural reference for obtaining the data required in the RRD. In preparing the work plan to address this RRD, procedures can be modified as applicable to obtain the data necessary to address the objectives and scope in Section 2.0. Because of anticipated low differential pressures, key elements to meeting the objective are the installation of sealed sample ports and the recording micromanometer.

# 2.0 Specialized Equipment

## 2.1 Sealed slab sample ports

For accurate differential pressure measurement between below the floor slab and the overlying occupied space, a correctly installed sealed sample port installed in the floor slab is required. It is recommended that after the hole is drilled through the floor slab using a rota-hammer, the sample port should be sealed into the concrete using the appropriate epoxy or similar permanent sealant.

If instrumentation-style shut-off (i.e. valved) quick connects are used, it may be advantageous to permanently install and seal a small diameter female pipe coupling into the concrete slightly below the top of the slab. Either the male or female side of the quick connect can then be threaded into this female into this coupling. Examples of instrumentation shut-off quick connects can be found at Swagelok (http://www.swagelok.com/products/quick-connects.aspx ) and other specialty valve and tubing manufacturers.

If an instrumentation shut-off quick connect is not used, then a ball shut-off valve should be installed on the top if the sample port to maintain the integrity of the system for pressure monitoring. This valve should remain closed at all times that the sample port is not being used.

## 2.2 Micromanometer and recorder

The Micromanometer needs to be able to meet the pressure and data logging requirements outlined in the definitions. Attachment 1 contains the specification sheets of two example micromanometers that meet the pressure requirements. One instrument has an internal data logging capabilities and the other requires connection to a computer to record data. The manometer should be calibrated and checked before each use using a standardized pressure gauge capable of reading low pressures. The range of the instrument should be ±1,000 Pascal (±4 inches of water column) or less with a resolution of 0.1 Pascal (0.0004 inches of water). The instrument should be capable of recording differential pressures for up to seven days at 15-minute intervals (~700 data points). The micromanometer should be capable measuring and recording both positive and negative pressures.

## 2.3 Barometric Pressure Recorder

Barometric pressure changes can affect the flow of vapor between the underside of the floor slab and the occupied space. Therefore it is important that barometric pressure be recorded at or near the site throughout the monitoring period. Barometric pressure should be recorded using a standard barometric pressure transducer and recording device. These are commonly available from environmental instrument suppliers (e.g. http://www.microdaq.com/tandd/tr-7u/three_channel_data_logger.php )

## 3.0 Definitions

- *Micromanometer*—An electronic instrument capable of measuring and recording differential pressures down to 0.1 Pascal (0.0004 inches of water).
- *Differential pressure*—Differential pressure is the difference in absolute pressure between two monitoring points. In the context of this RRD, differential pressure is the difference in the absolute pressure between below the floor slab and the overlying occupied space.

## 4.0 Procedure

The steps below can be used to monitor the differential pressure between the bottom of a floor slab and the occupied space.

### 4.1 Step 1—Install floor probe

Install the floor sample port in the selected location in the floor slab. Care must be taken to permanently seal the port into the concrete of the slab. Epoxy of similar sealant is recommended. If an instrument shut-in quick connect is to be used, then, depending on the quick connect being used, the female or male side of the quick connect is screwed into the port fitting using Teflon tape to seal the pipe threads. If a valve port is to be used, the ball or similar shut in valve should be installed on the port using a similar connection.

### 4.2 Step 2—Check port for leaks

After the port is installed, if possible it should be checked for leaks. However it is acknowledged that the floor slab configuration might limit or prevent leak checking of the port. If it is possible to leak check the port, the applied pressure should be one inch of water column.

### 4.3 Step 3—Connect and configure micromanometer

Install the micromanometer on the sample port using appropriate connection tubing.

Set up the micromanometer and recording system to record and store pressures according to the manufacturer's setup procedures. Set up the system to record on a 15-minute or less time interval. Check that the clock is set to record at local time. If

Turn the recording system on to start the monitoring period.

Check the instrument readout positive and negative pressure direction by applying very low pressure on the end of the sample port tube. Low pressure can be done by gently blowing across the end of the sample port tube while monitoring the pressure readout. When pressure is applied to the sample port tube, the readout should read positive pressure. This will mean if a positive pressure is measured during the monitoring period, the pressure on the underside of the floor slab is higher than in the occupied space. This pressure check should be recorded by the recording system so that the check data are available in the data file.

### 4.4 Step 4—Check system operation

After the system has been operational for several hours or overnight, it is important to download the data recorder to make sure the instrument is recording data properly. If it is working properly, it can be left unattended for the remainder of the monitoring period. If it is not working properly, then the micromanometer system must be repaired or adjusted to record the proper data.

### 4.5 Step 5—Download recorder and check data

At the end of the recording period, download the data to a field computer. The data file should be checked for completeness and integrity immediately upon downloading. The checks should include but are not limited to

- Completeness of the data record. Did the system record for the entire monitoring period and are the correct dates and times recorded correctly?
- Range of differential pressure values recorded. Are the differential pressures recorded in the ranges of expected values or are there outliers?

## 5.0 Attachments

### 5.1 Attachment 1

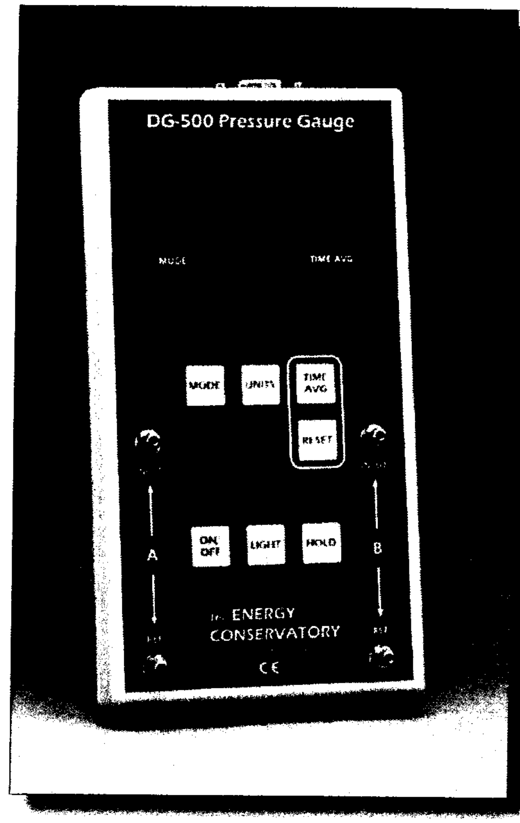
There are various micromanometers with the applicable pressure ranges with recording capabilities that can be used for collecting the subslab differential pressure data. Two examples of micromanometers that can be used to measure and record the differential pressures to the precision and accuracy required are included in Attachment 1.

- The FCO510 (http://www.furnesscontrols.com/difpres2.htm), is an industrial micromanometer that requires and external power supply.
- The DG-500 (http://www.energyconservatory.com/products/digital-pressure-gauges), is a battery powered field instrument that requires a computer for data logging.

## 6.0 FORMS

None but it is suggested that a data collection form be developed to record the installation, setup, and operation of the system.

# DG-500 Digital Pressure Gauge



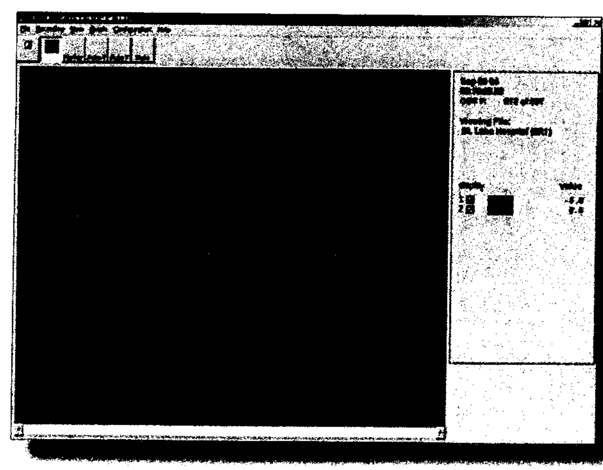

Today's building performance test procedures require diagnostic tools that are versatile, accurate and easy to use. The Energy Conservatory's new DG-500 Digital Pressure Gauge combines all these qualities into a sophisticated hand-held gauge that sets a new standard for performance testing equipment. The DG-500's advanced design gives you the power and flexibility needed to handle all types of building performance investigations.

The DG-500 Digital Pressure Gauge is a high resolution differential pressure gauge with 2 independent measurement channels. The DG-500's dual pressure channels and air velocity measurement features make it ideally suited for a wide range of building performance testing applications.

- Building pressurization and depressurization mapping - Accurately measure pressure imbalances from one room to another such as isolation suites or manufacturing clean rooms.
- Combustion safety testing - With 2 independent channels you can determine the effect of exhaust fans on both the combustion flue and the appliance room.
- Air handler and duct pressure measurements - Measure total external static pressure at the air handler, duct work static pressures and air velocity to help diagnose airflow performance problems.

## Quality Features

- Simultaneous display of 2 independent differential pressure channels, A and B.
- Accurate pressure measurements, ± 1% of reading from −1,250 to +1,250 Pascals, or -5 to +5 in. $H_2O$.
- Auto-zeroing of both measurement channels adjusts for position and temperature during operation.
- Choice of 4 time-averaging options, 1, 5, 10 second average and Long-Term or continuous average.
- Choice of velocity units on Channel B, fpm or m/s.
- A HOLD button temporarily freezes the most recent display readings.
- The DG-500 can be used along with a computer and TECLOG for Windows® software to conduct data logging of pressure measurements from both channels.



TECLOG is free data logging software that will record and graphically display pressure measurements from the DG-500. TECLOG is also capable of data logging from two DG-500 Gauges providing you with 4 channels of precision pressure measurement at a fraction of the cost of most pressure data loggers.

The DG-500's versatility and advanced features make it a "must have" tool for all performance testing contractors. Diagnostic tools from The Energy Conservatory are the cornerstones to more efficient, affordable, and healthy buildings and HVAC systems.

Call us for more information!

**The ENERGY CONSERVATORY**

**DIAGNOSTIC TOOLS TO MEASURE BUILDING PERFORMANCE**

# specifications

Number of Independent Pressure Channels: 2

Pressure Range: –1,250 to +1,250 Pascals (-5 to +5 in. $H_20$)

Display Resolution: 0.1 Pa (0.0001 in $H_20$)

Accuracy: 1% of pressure reading or .15 Pa, whichever is greater.

Units of Measure: Channel A – Pascals, in. $H_20$
Channel B - Pascals, in. $H_20$, fpm, m/s

Auto-Zero: On start up and then once every 10 seconds

Time Averaging: 1, 5, 10 seconds and Long-Term (continuous update)

Operating Temperature Range: 32° F to 120° F (0° C to 48° C)

Storage Temperature Range: -4° F to 160° F (-20° C to 71° C)

LCD Display: 3.193 x 1.16 in. (8.11 x 2.946 cm)

Display Backlight: Manually operated, timed off after 10 minutes.

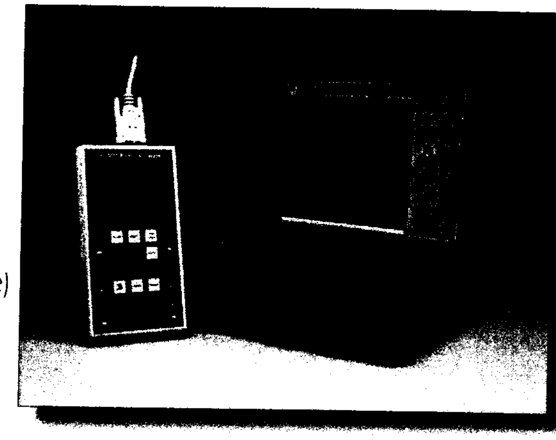
Power: 6 - AA alkaline batteries, supplied. AC power adapter optional.

Battery Life (Alkaline): Over 100 hours continuous use.

Auto-Off: After 2 hours from last keyed entry, unless disabled by user.

Weight: 16.5 oz. (0.468 kg)

Dimensions: 7.5 in. x 4 in. x 1.25 in. (19.5 cm x 10.16 cm x 3.175 cm)



**Modes**

Pressure/Pressure and Pressure/Velocity

**Data Logging**

Data logging of pressure measurements from both channels requires TECLOG for Windows®, available free at www.energyconservatory.com, and a serial cable to connect the DG-500 to a computer.

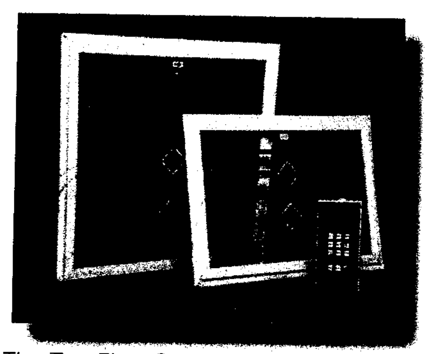
**Digital Gauge Kit include:**

DG-500 Digital Pressure Gauge, protective carrying case, static pressure probe, 10 ft (3 m) red hose, 15 ft (5 m) green hose, instruction manual, 2 year warranty.

Other building diagnostic products available from The Energy Conservatory

The Minneapolis Duct Blaster® measures the airtightness of duct work.

The IR-InSight™ Infrared Camera detects hidden air leakage paths in building cavities and components.



The TrueFlow® Air Handler Flow Meter measures the total amount of air moving through an air handler.

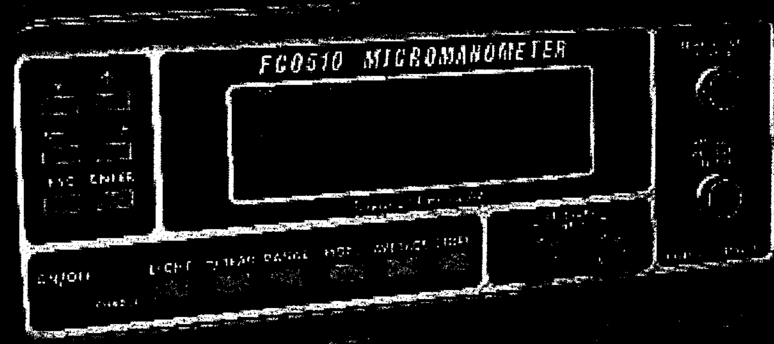
**To Order**, or for more information contact: **The Energy Conservatory**

2801 21st Avenue South, Suite 160
Minneapolis, Minnesota 55407
phone: 612–827–1117
fax: 612–827–1051
e–mail: info@energyconservatory.com
website: www.energyconservatory.com

FCO510

*Low Pressure*

# MICROPROCESSOR MICROMANOMETER




Furness Controls

FCO510

Furness Controls

FC0510

*Low Pressure*

# MICROPROCESSOR MICROMANOMETER

## RANGES

| | | |
|---|---|---|
| **Model 1:** | **20.000/200.00 Pa,** | **Velocity 18.000 m/s** |
| **Model 2:** | **200.00/2000.0 Pa,** | **Velocity 57.000 m/s** |
| **Model 3:** | **2.0000/20.000 kPa,** | **Velocity 180.00 m/s** |

Velocity ranges are stated for 1013 mb, 15°C

## SPECIFICATION

| | |
|---|---|
| Languages | English, French, German |
| Accuracy | 0.25% of reading between 10% of lowest range and full scale, ± one digit below 10%, better than 0.025% FSD |
| Storage temperature | -10°C to 50°C |
| Working temperature | 0°C to 45°C |
| Mains supply | 90 to 250 VAC 50 – 60 Hz |
| DC supply | 12 VDC min 350 mA |
| DC outputs | 18 VDC 25 mA for 4 to 20 mA sensors |
| Media compatibility | Dry non-corrosive gases, 0 to 95% relative humidity non-condensing, compatible with construction materials |
| Materials in contact | Copper, stainless steel, mica, silicone grease, loctite, nickel, hytrel |
| Maximum overload | 10 times instrument differential |
| Maximum static | 10 bar applied to both "plus" and "minus" ports simultaneously |
| Pneumatic fittings | For 6 mm OD by 4 mm ID tube |
| Flow devices | Laminar element or Pitot tube |
| External sensors | 4 to 20 mA loop powered. External source or 18 V internal supply |
| Temperature range | External sensor or preset value -100 to +800°C |
| Absolute pressure range | External sensor or preset value 0 to 11 bar |
| Relative viscosity range | 0.1 to 3.0 |
| Relative density range | 0.1 to 3.0 |
| Pitot K factor range | 0.5 to 3.0 |
| Duct cross-section range | 0.1 to 10.0 $m^2$ |
| Laminar flow range | 0.001 to 9999.999 l/m |
| D.P. for laminar flow element | 0.01 to 9999.99 pa |
| D.P. units | Pa, kPa, $mmH_2O$, "$H_2O$, μbar, mbar, mmHg, "Hg, thou, $Nm^{-2}$, PSF, PSI (model 2 and 3) |
| Velocity units | m/s, mph, ft/s, ft/m, km/h, Knots |
| Temperature units | °C, °F, °K |
| Absolute pressure units | kPa, mbar, bar, PSI, "Hg |
| Units for area | $cm^2$, $m^2$, $in^2$, $ft^2$ |
| Volume flow units | $mm^3/s$, ml/s, ml/m, ml/h, cc/s, cc/m, cc/h, l/s, l/m, l/h, $m^3/s$, $m^3/m$, $m^3/h$, $in^3/s$, $in^3/m$, $in^3/h$, $ft^3/m$, $ft^3/h$ |
| Mass flow units | Kg/s, kg/m, kg/h, lb/s, lb/m, lb/h |
| Display average time | 0.3 to 20.0 seconds |
| Other functions | Peak hold, valley hold, volume flow, mass flow, time, date, automatic zero, display of up to three parameters |
| Outputs | 0-5 VDC or 0-2.5-5 VDC |
| Temperature effect on zero with auto zero disabled | 0.02% FSD per °C |
| Temperature effect on range | 0.05% FSD per °C |
| Dimensions | 300 x 125 x 250 mm |
| Accessories | Robust aluminium carrying case with storage for leads and tubes |
| Datalogger | Built-in datalogger for storage of test results. Includes RS232C output for downloading to a PC or printer |
| Weight | 6 kilos |

Agents Stamp:

ST-65 XXXXXXXXXXX

FC0510

Furness Controls Limited

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E-mail: sales@furness-controls.com
Web site: http//www.furness-controls.com

Furness Controls has a UKAS certified laboratory which offers pressure calibration from 0 to 40 kPa and Flow calibration from 0.1 ml/min to 2000 litres/min

nqa. ISO 9001 Registered

UKAS QUALITY MANAGEMENT 015