



BOBBY JINDAL
GOVERNOR

State of Louisiana
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF CONSERVATION
THIRTEENTH AMENDMENT TO DECLARATION OF EMERGENCY
AND DIRECTIVE TO TEXAS BRINE COMPANY, LLC FOR
EMERGENCY SITUATION ASSOCIATED WITH COLLAPSE OF
OXY-GEISMAR NO. 3 CAVERN, WELL SN 180708

STEPHEN CHUSTZ
SECRETARY

JAMES H. WELSH
COMMISSIONER OF CONSERVATION

Pursuant to the authority granted to the Commissioner of Conservation and Assistant Secretary of the Louisiana Department of Natural Resources under La. R.S. 30:1, et seq., particularly La. R.S. 30:6.1, this THIRTEENTH AMENDMENT TO THE DECLARATION OF EMERGENCY AND DIRECTIVE is hereby issued;

It is hereby declared that since issuance of the Twelfth Amendment to the Declaration of Emergency and Directive effective November 19, 2014, and issued to Texas Brine Company LLC (T149) concerning a sinkhole that has occurred immediately adjacent to OXY GEISMAR NO. 3 well site (Serial Number 180708), the associated salt cavern, and the OXY GEISMAR NO. 3A observation well (Serial Number 974265), the following facts have been found to exist:

- 1) As required by the Fourth Amendment to the Declaration of Emergency and Directive effective November 12, 2012, Texas Brine Company, LLC (T149) (TBC) submitted the Recommendation for Area of Gas Depletion -East of Grand Bayou, dated November 24, 2014. The Office of Conservation (Office) responded in correspondence dated December 4, 2014 in which this Office stated "TBC shall submit a brief work plan to demonstrate confirmation of gas depletion (since revised as a Request for No Further Action) with current data for the area east of Grand Bayou," with the requirements outlined in ATTACHMENT A.
- 2) TBC responded to this Office's December 4, 2014, correspondence with additional information on December 12, 2014, and stated "*TBC sees no technical basis for performing any additional analysis or data collection to support the classification of the East of Grand Bayou Area as an Area of Gas Depletion,*" (since revised as a Request for No Further Action). This Office responded in correspondence dated January 10, 2015, still requiring "*submittal of a brief work plan to demonstrate confirmation of gas depletion (since revised as a Request for No Further Action) with current data for the area east of Grand Bayou,*" however, with reduced requirements (ATTACHEMENT B) based on the additional information submitted with TBC's December 12, 2014 response.
- 3) A conference call was held between this Office and TBC on February 2, 2015, in which it was determined that TBC would provide additional, supporting documentation for their Request for No Further Action for the Area East of Grand Bayou.
- 4) This Office provided a letter (ATTACHEMENT C) to TBC dated March 10, 2015, in which this Office documented all correspondence regarding the Area East of Grand Bayou and requiring TBC to submit "*a revised Justification for a No Further Action at This Time for the Area East of Grand Bayou, no later than Monday, March 16, 2015.*"

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5) TBC submitted the *Recommendation for No Further Action Determination – East of Grand Bayou Area* in a submittal dated March 31, 2015. This Office responded in correspondence dated April 30, 2015 (ATTACHMENT D), with comments on TBC’s March 31, 2015 submittal.

6) This Office, CB&I, Assumption Parish OEP, and Tetra Tech (on behalf of TBC) met on May 18, 2015, to discuss the main topics brought up in the comments provided by this Office in its April 30, 2015, correspondence.

Therefore, until further notice, based upon the findings herein listed as well as those findings set forth in the original and previous amendments to the declaration of emergency/directives, it is determined that the requirements for declaring an emergency pursuant to La. R.S. 30:6.1 have been met and an emergency continues to exist due to the incidents which have occurred, are occurring, or threaten to occur imminently at the OXY GEISMAR NO. 3 well (Serial Number 180708) facility and site.

It is hereby declared that in response to the emergency, Texas Brine Company LLC (T149) is **hereby ordered** to undertake any and all necessary actions to assess for and abate threats to human safety and the environment associated with the OXY GEISMAR NO. 3 well (Serial Number 180708) facility and site.

It is further declared that Texas Brine Company LLC (T149) is specifically directed and is **hereby ordered** to undertake the necessary actions to address the potential danger to human life associated with the OXY GEISMAR NO. 3 well (Serial Number 180708) facility and site, which at a minimum shall require the following:

1. By no later than June 5, 2015, Texas Brine Company LLC (T149) shall provide a work plan to demonstrate that No Further Action is necessary at this time.

The work plan shall include:

- a. Two Confirmatory CPTs shall be advanced in the vicinity of the residential homes (one at each location) located in the area east of Grand Bayou. Provide a map of approximate confirmation locations.
- b. Dissipation tests shall be conducted at all lithology with a designation of 7 through 10 as defined on the CPT logs (silty sand to sandy silt, sand to silty sand, sand, and gravelly sand to sand). Dissipation tests shall be conducted at depth interval frequencies that adequately demonstrate thickness or absence of gas.
- c. Gas samples shall be attempted to be collected from shallow wells GP-ORW-27 and NSDMW011 and analyzed to determine if any collected gas is biogenic or thermogenic.

THIRTEENTH AMEND. TO THE DECLARATION OF EMERGENCY AND DIRECTIVE

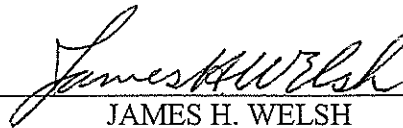
It is further declared that, consistent with La. R.S. 30:6.1.B, if Texas Brine Company LLC (T149) fails to begin the actions listed above prior to the deadline(s) established herein, orders demanding compliance and civil penalties may be issued to Texas Brine Company LLC (T149) R.S. 30:1, et seq.

It is further declared that for purposes of this Declaration of Emergency and Directive any and all reports and results from the activities detailed above shall be submitted to the Office of Conservation via e-mail at conservationorder@la.gov. Please reference "Twelfth Amendment Emergency Declaration – Texas Brine Company LLC – May 22, 2015" on any and all related correspondence.

In the event Texas Brine Company LLC (T149) believes it is aggrieved by this action, then within 20 days of receipt of this Emergency Declaration and Directive, Texas Brine Company LLC (T149) may make a written request for a public hearing. A public hearing request must be accompanied by a check or money order in the non-refundable amount of \$755 as provided by LAC 43:XIX.Chapter 7, or the request for hearing will be denied. Be advised that pursuant to La. R.S. 30:6.1.D, "any request for hearing, appeal, or request for review [of this emergency declaration and directive] shall not suspend the implementation of the action ordered."

Texas Brine Company LLC's (T149) failure to request a hearing, or to file an appeal, or the withdrawal of a request for hearing on this Emergency Declaration and Directive shall not preclude Texas Brine Company LLC (T149) from contesting the commissioner's findings of facts in any subsequent administrative or judicial proceeding or action.

SO DECLARED, ORDERED, AND DONE this May 26, 2015 at Baton Rouge, Louisiana.



JAMES H. WELSH

AR COMMISSIONER OF CONSERVATION



BOBBY JINDAL
GOVERNOR

State of Louisiana
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF CONSERVATION

STEPHEN CHUSTZ
SECRETARY
JAMES H. WELSH
COMMISSIONER OF CONSERVATION

December 4, 2014

The Louisiana Department of Natural Resources, Office of Conservation (LDNR/OC) has reviewed the *Recommendation for Area of Gas Depletion – East of Grand Bayou* submitted and dated November 24, 2014. LDNR/OC has also reviewed the information provided on the BOX.com website and information presented by Texas Brine Company, LLC (TBC) on December 2, 2014, in replies to emails from this Office.

Based on the submittal(s), data was provided from the following:

1. Four cone penetrometer test (CPTs) data locations:
 - a. CPT-1, 4/23/2013
 - b. CPT-04, 5/13/2013
 - c. CPT-18, 6/13/2013
 - d. CPT-9/9R, 5/29 and 9/5/2013
2. Three Membrane Interface Hydraulic Profiling Tool (MiHPTs) data locations:
 - a. ORW-27 MiHPT-08, 8/5/2013
 - b. MiHPT-18, 9/9/2013
 - c. MiHPT-209(CPT 09), 9/9/2013
3. Two observation relief wells (ORWs):
 - a. ORW 27, plugged and abandoned 9/25/2014
 - b. ORW 33, scheduled to be plugged and abandoned (TBD)
4. Three direct-push wells:
 - a. NSDMW012
 - b. NSDMW011, analytical data 10/18/2012
 - c. GP-ORW-27, analytical data 5/28/2013

Based on the referenced submittal and supporting information, TBC shall submit a brief work plan to demonstrate confirmation of gas depletion with current data for the area east of Grand Bayou, to include the following:

1. Confirmatory CPTs in the vicinity of the previous CPT and MiHPT locations listed above. An additional CPT location should also be completed north of Hwy 70. Provide a map of approximate confirmation locations.
2. Dissipation tests shall be conducted at all lithology with a designation of 7 through 10 as defined on the CPT logs (silty sand to sandy silt, sand to silty sand, sand, and gravelly sand to sand). Dissipation tests shall be conducted at depth interval frequencies that adequately demonstrate thickness or absence of gas.

TBC should submit previously completed CPT and MiHPT logs and identify proposed dissipation testing intervals based on the lithology criteria above as well as any previously

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identified gas. This Office understands that future CPT location depths and lithology may be different than historically completed locations, however, to ensure consistent objectives between this Office and TBC, the requested information should be submitted.

3. Gas samples shall be attempted to be collected from shallow wells GP-ORW-27 and NSDMW011 and analyzed to determine if any collected gas is biogenic or thermogenic.
4. NSDMW012 shall be plugged and abandoned.

The work plan shall be submitted to this Office on or before December 12, 2014.

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Attachment B



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State of Louisiana
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF CONSERVATION

STEPHEN CHUSTZ
SECRETARY
JAMES H. WELSH
COMMISSIONER OF CONSERVATION

January 10, 2015

The Louisiana Department of Natural Resources, Office of Conservation (LDNR/OC) reviewed the *Recommendation for Area of Gas Depletion – East of Grand Bayou* submitted and dated November 24, 2014, and the information provided on the BOX.com website and information presented by Texas Brine Company, LLC (TBC) on December 2, 2014, in replies to emails from this Office.

This Office submitted correspondence, dated December 4, 2014, directing Texas Brine Company, LLC to submit a brief work plan to demonstrate confirmation of gas depletion with current data for the area east of Grand Bayou. The requirements of that work plan were outlined below:

1. *Confirmatory CPTs in the vicinity of the previous CPT and MiHPT locations listed above. An additional CPT location should also be completed north of Hwy 70. Provide a map of approximate confirmation locations.*
2. *Dissipation tests shall be conducted at all lithology with a designation of 7 through 10 as defined on the CPT logs (silty sand to sandy silt, sand to silty sand, sand, and gravelly sand to sand). Dissipation tests shall be conducted at depth interval frequencies that adequately demonstrate thickness or absence of gas.*

TBC should submit previously completed CPT and MiHPT logs and identify proposed dissipation testing intervals based on the lithology criteria above as well as any previously identified gas. This Office understands that future CPT location depths and lithology may be different than historically completed locations, however, to ensure consistent objectives between this Office and TBC, the requested information should be submitted.

3. *Gas samples shall be attempted to be collected from shallow wells GP-ORW-27 and NSDMW011 and analyzed to determine if any collected gas is biogenic or thermogenic.*
4. *NSDMW012 shall be plugged and abandoned.*

Texas Brine Company, LLC responded to LDNR/OC's December 4, 2014 correspondence with additional information on December 12, 2014 and stated "TBC sees no technical basis for performing any additional analysis or data collection to support the classification of the East of Grand Bayou Area as an Area of Gas Depletion."

Based on review of the additional submittal and supporting information from December 12, 2014, referenced above, this Office is still requiring submittal of a brief work plan to demonstrate confirmation of gas depletion with current data for the area east of Grand Bayou. However, based on review of the additionally submitted information, the revised requirements of that work plan are outlined in the following numbered statements.

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1. Two Confirmatory CPTs shall be advanced in the vicinity of the residential homes (one at each location) located in the area east of Grand Bayou. Provide a map of approximate confirmation locations.
2. Dissipation tests shall be conducted at all lithology with a designation of 7 through 10 as defined on the CPT logs (silty sand to sandy silt, sand to silty sand, sand, and gravelly sand to sand). Dissipation tests shall be conducted at depth interval frequencies that adequately demonstrate thickness or absence of gas.
3. Gas samples shall be attempted to be collected from shallow wells GP-ORW-27 and NSDMW011 and analyzed to determine if any collected gas is biogenic or thermogenic.

Until such time TBC collects and submits the current data as required above, this Office cannot consider issuing a statement that no further action is required at this time for the area east of Grand Bayou.

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Attachment C



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DEPARTMENT OF NATURAL RESOURCES
OFFICE OF CONSERVATION

STEPHEN CHUSTZ
SECRETARY
JAMES H. WELSH
COMMISSIONER OF CONSERVATION

March 10, 2015

Bruce Martin and Joel Warneke
Texas Brine Company LLC (T149)
4800 San Felipe
Houston, Texas 77056

via electronic correspondence

RE: Area East of Grand Bayou Submittal

Messrs. Bruce Martin and Joel Warneke:

Texas Brine Company, LLC (TBC) submitted *Recommendation for Area of Gas Depletion – East of Grand Bayou* on October 13, 2014. Various electronic correspondence and a conference call have occurred since the initial October 13, 2014 submittal. A summary of the Electronic correspondence to and from the Louisiana Department of Natural Resources, Office of Conservation (LDNR/OC) that were sent to or received from TBC are included at the bottom of this correspondence.

The last electronic correspondence from the LDNR/OC to TBC was February 2, 2015 and requested an anticipated time frame for when TBC would submit a revised Justification for the East Side based on the February 2, 2015, conference call discussions. To date, no revised submittal has been received.

Therefore, TBC shall submit a revised Justification for a No Further Action at This Time for the Area East of Grand Bayou, no later than Monday, March 16, 2015.

LDNR/OC and TBC Electronic Correspondence Regarding the Area East of Grand Bayou

1. LDNR/OC to TBC dated **October 22, 2014** requesting additional information
2. LDNR/OC to TBC dated **November 17, 2014**, requesting status of revised Justification.
3. TBC to LDNR/OC dated **November 17, 2014**, stating revised Justification will be submitted next week.
4. TBC to LDNR/OC dated **November 24, 2014**, including *Recommendation for Area of Gas Depletion – East of Grand Bayou 11-24-14*.
5. LDNR/OC to TBC dated **November 26, 2014**, confirming receipt of November 24, 2014 submittal.
6. LDNR/OC to TBC dated **December 1, 2014**, with comments and questions to November 24, 2014 submittal.
7. TBC to LDNR/OC dated **December 1, 2014**, with partial responses to previous electronic correspondence.

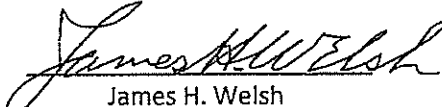
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8. LDNR/OC to TBC dated **December 1, 2014**, responding to previous electronic correspondence with additional questions.
9. TBC to LDNR/OC dated **December 2, 2014**, with partial response to previous electronic correspondence.
10. TBC to LDNR/OC dated **December 2, 2014**, with responses to previous LDNR/OC electronic correspondence.
11. LDNR/OC to TBC dated **December 4, 2014**, requesting work plan for confirmatory sampling.
12. TBC to LDNR/OC dated **December 4, 2014**, confirming receipt of previous electronic correspondence.
13. TBC to LDNR/OC dated **December 12, 2014**, in response to LDNR/OC's request for confirmatory sampling work plan.
14. LDNR/OC to TBC dated **December 15, 2014**, confirming receipt of December 12, 2014 response.
15. LDNR/OC to TBC dated **December 23, 2014**, stating LDNR/OC would propose a meeting after review/comment of December 12, 2014 TBC submittal.
16. TBC to LDNR/OC dated **January 7, 2015**, requesting status of meeting.
17. LDNR/OC to TBC dated **January 10, 2015**, requesting a confirmatory sampling work plan with revised requirements.
18. TBC to LDNR/OC dated **January 13, 2015**, requesting status of a meeting.
19. LDNR/OC to TBC dated **January 13, 2015**, requesting confirmation of receipt of January 10, 2015, work plan request and proposing conference call date and time.
20. TBC to LDNR/OC dated **January 13, 2015**, confirming receipt and requesting postponing conference call until next week as TBC personnel were out of the country.
21. LDNR/OC to TBC dated **January 20, 2015**, requesting date and times from TBC to conduct conference call.
22. LDNR/OC to TBC dated **January 29, 2015**, requesting availability for Monday, February 2, 2015, for conference call.
23. TBC to LDNR/OC dated **January 29, 2015**, stating availability for Monday conference call and requesting specific information regarding the call.
24. LDNR/OC to TBC dated **January 29, 2015**, stating that call is an informal and general discussion on LDNR/OC's expectations for obtaining a No Further Action at This Time for East Side.
25. TBC to LDNR/OC dated **January 29, 2015**, confirming conference call.
26. Conference Call on **February 2, 2015**, between LDNR/OC and TBC.
27. LDNR/OC to TBC dated **February 2, 2015**, requesting expected date of follow-up submittal.
28. TBC to LDNR/OC dated **February 2, 2015**, stating TBC will get back with LDNR/OC later in the week to provide an idea of when additional information will be submitted.
29. TBC to LDNR/OC dated **February 3, 2015**, providing partial information to discussion topic in February 2, 2015 conference call.

If you have any questions, you may contact Travis Williams at (225) 342-7213 or travis.williams@la.gov.

Yours very truly,


James H. Welsh
Commissioner of Conservation

Cc: John Boudreaux, OEP
Ted Borer, Tetra Tech

Attachment C D



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April 30, 2015

**Recommendation for No Further Action Determination – East of Grand Bayou Area (Tetra Tech)
dated March 31, 2015**

The referenced correspondence was in response to the March 23, 2015 Louisiana Department of Natural Resources/Office of Conservation (LDNR/OC) request for information to demonstrate confirmation of gas depletion for the proposed area east of Grand Bayou.

In a letter dated December 4, 2014, the LDNR/OC had requested that four items concerning gas depletion in the area east of Grand Bayou be addressed as follows:

Confirmatory CPTs in the vicinity of the previous CPT and MiHPT locations in the area with an additional CPT to be installed north of Highway 70. Provide a map of approximate confirmation CPT locations.

Dissipation tests shall be conducted at all lithology with a designation of 7 through 10 as defined on the CPTs logs (silty sand to sandy silt, sand to silty sand, sand, and gravelly sand to sand). Dissipation tests shall be conducted at depth interval frequencies that adequately demonstrate thickness or absence of gas.

Gas samples shall be attempted to be collected from shallow wells GP-ORW-27 and NDSMW011 and analyzed to determine if any collected gas is biogenic or thermogenic. NSDMW012 shall be plugged and abandoned.

In response to this request of December 4, 2014, TBC submitted the December 12, 2014 document titled Response to Comments Received from LDNR on December 4, 2014 Regarding Recommendations for Area Gas Depletion – East of Grand Bayou. For LDNR/OC Requirements 1 and 2, TBC stated that confirmatory CPTs are not required to support the determination that the previous CPTs provide adequate data to show that any gas detected in the area east of Grand Bayou does not pose a threat to the public. In response to LDNR Requirement 3, TBC stated that gas samples previously have been collected and analyzed for wells ORW-27, GP-ORW-27, and NDSMW011. In response to LDNR Requirement 4, TBC provided a work plan for the plugging and abandonment of shallow geoprobe well NSDMW012.

The LDNR/OC submitted comments dated December 23, 2014 on the December 12, 2014 Response to Comments. These comments stated that the TBC responses to LDNR/OC Requirements 1, 2, and 3 were not adequate. The comments stated that the plugging and abandonment plan submitted in response to LDNR/OC Requirement 4 was adequate.

On March 31, 2015, TBC submitted the Recommendation for No Further Action Determination – East of Grand Bayou Area document.

Comments are provided below for the March 31, 2015 submittal:

Comment 1. In the first bulleted item under the list of statements as evidence supporting a No Further Action Determination, it is stated that “No recoverable gas has been identified east of Grand Bayou based on the installation of four CPTs and two ORWs, refer to attached figure.”

Four CPT locations were completed east of Grand Bayou and include CPT-1, CPT-4, CPT-18, and CPT-9/9R in April 2013, May 2013, June 2013, and May 2013/September 2013, respectively.

CPT-1 and CPT-04 were completed during the initial trial phase of the CPT program and most of the data generated from the dissipation tests for these two CPTs did not meet the testing criteria/protocols.

Two recovery wells completed in the MRAA within the East Area were:

ORW-27 - perforated at 158 to 162 ft bgs, which is below the total depth of CPT-1 and MiHPT-8.

ORW-33 - perforated at 142 to 146 ft bgs, which is near the interpreted top of the MRAA sand where gas would be expected to accumulate.

ORW-27 and ORW-33 were installed in an area where the base of the clay aquitard is at greater depths and the accumulation of gas is not expected based on the structural low in this area.

No recovery well has been installed near CPT-9R/MiHPT-209 to determine if gas is producible at this location. The dissipation test at 110.3 feet below ground surface (ft bgs) in CPT-9 (on 5/29/13) was interpreted by TBC's contractor as follows: “Dissipation curve shapes indicative of gas presence but consistent tracking of hydrostatic pressure to depth trend and U2 push shapes (including from re-push) suggests that presence is minor.” Other dissipation tests from 108.23, 41.7, 38.05, 36.9, 35.26, and 34.32 ft bgs were interpreted with dissipation curve shapes indicative or somewhat indicative of gas and interpreted as presence of minor gas (and the later updated dissipation test summary table indicating no obvious gas) due to hydrostatic pressure to depth trend and U2 push shapes. When CPT-9R was pushed (on 9/5/13), the only interval retested was below 111.08 feet but the top of the sandy zone appears to start at a depth of approximately 107.8 ft bgs. If gas were present in this interval it would have been missed by the repeat dissipation test. As noted above, MiHPT-209, located adjacent to CPT-9/9R, showed the presence of gas at several depth intervals near 26 ft bgs, 104 ft bgs, 110 ft bgs, and 124 ft bgs.

When interpreting the hydrostatic pressures on CPT-9R, the green hydrostatic pressure line on the U2 plots is the maximum hydrostatic pressure that would be expected (based on a calculated hydrostatic pressure with a groundwater level at the ground surface) so all the dissipation test results for CPT-9R below 111 feet exceed the expected hydrostatic pressure by a minimum of about 2 pounds per square inch (psi). If the actual depth to groundwater is less than at the ground surface, the pressure from the dissipation test may be more than 2 psi over the calculated hydrostatic pressure (green line on the plots).

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There was also some data from CPT-9 and CPT-18 that did not meet the testing criteria/protocols. The data that did not meet the specified criteria may not be considered reliable with respect to identifying recoverable gas at these former CPT locations.

No ORW has been installed near CPT-9R or CPT-18 to determine if the gas identified in these CPTs and in this area is recoverable. Significant gas recovery is ongoing at ORW-57 located just west of Grand Bayou.

Comment 2. In the second bulleted item under the list of evidence supporting a No Further Action Determination, it is stated that "No gas production was possible from the two installed ORWs in this area."

As stated above, ORW-27 and ORW-33 were installed in an area where the base of the clay aquitard is at greater depths and the accumulation of gas is not expected based on the structural low in this area.

Comment 3. In the third bulleted item under the list of evidence supporting a No Further Action Determination, it is stated that "LDNR approved the request to abandon the two ORWs in this area."

The LDNR/OC assesses the gas conditions and ORW operational phases based on the well construction relative to the gas zones and history of each ORW. As this Office has stated in multiple correspondence, the operational phases assign a status to each well and not to a geographic area.

Comment 4. In the fourth bulleted item under the list of evidence supporting a No Further Action Determination, it is stated that "The chance that there is any recoverable gas present in either the MRAA, aquitard or shallow sand zones is extremely low based on soil analytical testing and vertical gas migration modeling."

The following list summarizes the CPT intervals that have been interpreted by TBC to show gas:

CPT-1 was the first CPT and had a limited number of dissipation tests that may not have been in the most appropriate depth locations to evaluate gas presence. The dissipation test at approximately 111.9 feet was located approximately 2 feet below the top of the sandy interval.

CPT-4 was an early conducted CPT with a limited number of dissipation tests that may not have been in the most appropriate depth locations to evaluate gas presence. The test at near 104.7 ft bgs was completed near the bottom of the permeable interval with only one test in this interval. Gas was interpreted at a depth interval of approximately 143.3 to 144.2 ft bgs. Based on the U2 shape it is possible that gas interval might be interpreted at greater than 2 feet thick.

CPT-9/9R dissipation test at 110.3 ft bgs in CPT-9 (on 5/29/13) was interpreted by TBC's contractor as follows: "Dissipation curve shapes indicative of gas presence but consistent tracking of hydrostatic pressure to depth trend and U2 push shapes (including from repush) suggests that presence is minor." Other dissipation tests from 108.23, 41.7, 38.05, 36.9, 35.26, and 34.32 ft bgs were interpreted with dissipation curve shapes indicative or somewhat indicative of gas and interpreted as presence of minor gas due to hydrostatic pressure to depth trend and U2 push shapes. When CPT-9R was pushed (on 9/5/13), the only interval retested was below 111.08 feet when the top of the sandy zone appears

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to start at a depth of approximately 107.8 ft bgs. If gas were present in this interval it would have been missed by the dissipation test.

CPT-18 was interpreted to show gas at approximately 141.2 at the bottom of the push. No tests were completed below this depth so the true thickness of the gas below 141.2 ft bgs is not known.

CPT-78W was interpreted to show minor gas less than 0.5 feet thick at 144.2 ft bgs. A test at 145.01 ft bgs was also stated to show gas. No tests were completed below this depth so the true thickness of the gas below 145.01 ft bgs is not known.

CPT-79W was interpreted to show minor gas less than 0.5 feet thick at 138.3 ft bgs.

CPT-80W was interpreted to show minor gas about 0.5 feet thick at 144.36 ft bgs. The test above near 141 ft bgs did not appear to have been completed in the permeable unit so it is possible an interval of gas (< 1 ft) may have been missed.

CPT-83W was interpreted to show no gas.

CPT-117 was interpreted to show no gas.

CPT-118W was interpreted to show significant gas about 5 feet thick from approximately 123.25 feet bgs to 128.12 feet bgs. No additional dissipation testing was done below 128.12 feet at CPT-118W due to refusal. Therefore the base of the gas was not identified at this location.

In most instances, the gas thicknesses were based on interpretation as thin of an interval as possible based upon the data.

As noted above, CPT-1 (April 2013) and CPT-4 (May 2014) were completed during the initial trial phase of the CPT program and most of the data generated from the dissipation tests for these two CPTs did not meet the testing protocols later agreed to by TBC's consultant. There was also some data from CPT-9 and CPT-18 that did not meet the testing criteria/protocols. This data may not be considered reliable with respect to identifying recoverable gas at these locations.

It is evident from this information that thin intervals of gas were identified in the majority of the CPT locations in this area. The assertion that the structural configuration of the base of clay above the MRAA is not amenable to the accumulation of gas may not be correct throughout this area. Some of the total gas thicknesses in the CPTs could not be measured because the last dissipation test where gas was identified was at the bottom of the CPT push (most notably at CPT-18).

Please also see comment No. 9 below.

Comment 5. In the fifth bulleted item under the list of evidence supporting a No Further Action Determination, it is stated that "Gas pressure monitoring data from shallow pressure monitoring wells is currently well below hydrostatic pressure."

For gas to show a wellhead pressure or to discharge to the ground surface, requires that gas pressures exceed hydrostatic pressure at locations where separate-phase gas has accumulated in the subsurface. Recent information that is pertinent to the site conditions includes the following:

Wellhead pressures measured at shallow well GP-ORW-27 increased from May 2014 to December 2014, but showed no measurable pressure in January and February 2015. Shallow well NSDMW012 showed no measurable pressure from September 2014 to February 2015. Shallow well NSDMW011 has shown wellhead pressures of 0.7 psi and greater from October 2014 through February 2015.

Significant gas is being produced from ORW-57 (installed in February 2014) located just west of the East Area.

Bubble sites NSDBS002 and NSDBS003, located in Grand Bayou and equipped with Knight Gas Caps, are still showing significant flow rates of gas at 8 standard cubic feet per hour (scf/h) and 9 scf/h (based on data from 2/18/15). The gas flow rates at both of these bubble sites are showing an increasing trend since the Knight Gas Caps were installed. The ongoing discharge of gas indicates that gas pressures in the subsurface exceed the hydrostatic pressure of the groundwater.

Eight additional bubble sites (NSDBS107, 1, 106, 104, 103, 87, 97, and 110), located in Grand Bayou east of ORW-57 and adjacent to the East Area, are still bubbling at the surface. The ongoing discharge of gas indicates that gas pressures in the subsurface exceed the hydrostatic pressure of the groundwater.

Comment 6. In the seventh bulleted item under the list of evidence supporting a No Further Action Determination, it is stated that "The elevation of the top of the MRAA in this area is significantly deeper (10-20 feet) than the area to the west and surrounding the sinkhole, thus restricting gas flow to this area."

The CPT data reported by TBC show the top of the MRAA to be approximately -142 to -138 feet mean sea level (msl) in the area east of Grand Bayou. The objective of the confirmatory CPTs is to test not only the upper part of the MRAA but also the overlying aquitard (confining layer) for the presence of gas.

The distribution of gas in the area may vary depending on the specific geologic conditions and should not be generalized as occurring at or above a specific elevation. Each location should be evaluated based on the location-specific geologic conditions.

In the previous report dated October 6, 2014 on the Analysis of Gas Cap Depletion in Relation to BRC Gas Framework Document, the interpreted composite gas thickness in the interval deeper than 80 feet was shown on Figure 1 of that report. This figure showed an area of gas ranging from 0.5 to 7 feet thick extending to the east of Grand Bayou in the area south of ORW-33 including CPT-9R and CPT-18. This gas thickness is based on CPT and MiHPT data. The occurrence of gas in this area is supported by the gas venting observed in ORW-57 located approximately 200 feet west of Grand Bayou and the identification of gas at nearby CPT-118W. The gas remediation radius of influence of ORW-57 was estimated to be 330 feet, but it was concluded that ORW-57 would not be sufficient to deplete the gas cap in this area.

At CPT-9R located southeast of ORW-57, the base of the lower aquitard clay is at an elevation of approximately -107 feet msl based on the presence of sand at this depth. This sand interval may not represent the true top of the MRAA in this area, but results in a structurally high area of higher permeability where gas would be likely to accumulate. Significant accumulations of gas occur in other

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areas of the Bayou Corne area in a thick sandy zone at approximately this same depth above the true top of the MRAA.

The structurally high sand interval in CPT-9R may be connected to a similar shallow sandy zone encountered at ORW-57 located to the west. CPT-126, located at ORW-57, shows this sand interval occurring from approximately -108 to -114 feet msl. Dissipation tests for this interval of CPT-126 were interpreted to not show gas. The production of gas at ORW-57 is from a deeper interval (near the top of the MRAA) with a screened interval from 123.1 to 131.1 ft bgs. The interpreted absence of gas at the shallower depth in ORW-57 does not mean gas is not present in this same interval in the area of CPT-9/9R. MiHPT-209 located near CPT-9/9R shows gas in multiple intervals including depths of approximately 26 ft bgs, 104 ft bgs, 110 ft bgs (approximately 5 feet of gas), and 124 ft bgs. This confirms that gas occurs in the sand interval above the MRAA near a depth of 110 feet. Data from other CPTs in the area (CPT-126, CPT-118W, CPT-81A and 81B, CPT-88W, CPT-101W, CPT-5, and CPT-129) should be used to help define the base of clay structural elevation in the vicinity of ORW-57 and at CPT-9R to the east so that the potential occurrence of gas can be better understood.

The structure of the base of the clay at the top of the MRAA could have limited influence on the lateral and vertical migration of gas within the overlying aquitard. The pathways of gas migration from the disturbed zone below the sinkhole into the MRAA and then into the overlying aquitard are not well understood. Gas migration could be occurring laterally below the sinkhole and then migrating vertically upward into the aquitard without being dependent only on collecting in areas where the top of the MRAA is structurally high.

Comment 7. The second part of the March 31, 2015 submittal is Attachment A titled Additional Responses to LDNR Comments and Concerns. The first item of Attachment A of the March 31, 2015 submittal is on Isotopic Gas Analysis. It is stated that "Water (dissolved gas) samples have previously been collected and analyzed for wells ORW-27, GP-ORW-27 and NSDMW011. This analytical data was submitted to LDNR on December 2, 2014. This data confirms that gas at these three well locations is biogenic in origin and not thermogenic gas liberated as a result of the sinkhole formation."

These isotopic composition results from wells ORW-27, GP-ORW-27 and NSDMW011 are based on dissolved methane in groundwater. It is possible that much of the dissolved methane in groundwater is microbial in origin. On the other hand, the thermogenic gas is believed to be migrating to the surface along discrete pathways as a gas phase and could have limited potential for dissolving in the groundwater. Previous isotopic results for free gas samples collected at bubble sites in Grand Bayou and the swamp near the East Side indicate the majority of the gas has been of thermogenic origin. Isotopic results for free gas samples from ORWs indicated the majority were thermogenic with some biogenic and mixed thermogenic-biogenic compositions. As shown on Figure 5-7 of RESPEC's Passive Vent Well and Knight Gas Cap October 2014 Monthly Field Activity and Data Summary Report submittal, the isotopic data for gas samples from bubble sites NSDBS002, 8, 15, and 87 indicate a thermal gas signature for these locations.

Dissolved gas samples from ORW-27 and GP-ORW-27 have indicated a biogenic origin; however, the isotopic data indicated these are biogenic gas from carbon dioxide reduction and differ from microbial gas derived from fermentation of dissolved organic matter. Isotopic analyses for dissolved gases in water samples from several industrial water wells (well numbers 007-80, -81, -87, -98, and -131 located east of Grand Bayou within the East Area) indicated biogenic and mixed biogenic and thermogenic origins, suggesting that thermogenic gas also is present in this area. The differences

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between the dissolved gas and separate-phase gas isotopic compositions show the need for the collection and isotopic analysis of gas-phase methane from the area east of Grand Bayou.

Comment 8. In the second item of Attachment A of the March 31, 2015 submittal (CPT Dissipation Tables), it is stated that "TBC previously updated the CPT dissipation tables, Basis of Gas Interpretation for Cone Penetration Test Sounding, to address the comments received verbally from LDNR's representative on December 8, 2014. The updated tables were submitted with the TBC response to LDNR dated December 12, 2014 and are attached. These updated tables show that any potential gas zones have been adequately tested by the existing CPT (CPT-1, CPT-4, CPT-9 & 9R, and CPT-18) locations."

The updated tables have been reviewed to assess the occurrences of gas. The following list summarizes comments related to the gas interpretations for each of these CPTs:

CPT-1

Trial phase of the CPT gas assessment technology
Limited number of dissipation tests
Did not test all sands (50-foot interval, 104.5 sand)
Only one test in sand intervals at 102.76, 111.88, and 113.71 ft bgs
Did not always test the top of the sand interval (e.g., near 105, 110, 112.5, 140 ft bgs)
Four of the seven tests did not meet agreed upon testing criteria/protocol

CPT-4

Trial phase of the CPT gas assessment technology
Limited number of dissipation tests
Only one test in sand interval at 41.2 ft bgs
Did not always test the top of the sand interval (e.g., near 38.5 and 103.5 ft bgs)
Six of the seven tests did not meet agreed upon testing criteria/protocol
Gas identified near 143.5 ft bgs in middle of a sand interval

CPT-18

Limited number of dissipation tests
Only one test in sand interval at 141.5 ft bgs due to refusal at maximum depth
Did not always test the top of the sand interval (e.g., near 53.5 and 108 ft bgs)
Six of the 13 tests did not meet agreed upon testing criteria/protocol
The blue hydrostatic pressure fit line is always higher pressure than the green calculated hydrostatic pressure line, indicating pressures potentially higher than hydrostatic
Hydrostatic pressure decline occurred where gas was identified near 141.5 feet bgs

CPT-9/9R

Limited number of dissipation tests
Only one test in sand interval at 86 ft bgs and 100 ft bgs in CPT-9 and 108 ft bgs in CPT-9R
Did not always test the top of the sand interval (e.g., near 86 and 100 ft bgs in CPT-9 and 108 ft bgs in CPT-9R)
Two of the 21 tests did not meet agreed upon testing criteria/protocol
Blue hydrostatic pressure fit line is always higher pressure than the green calculated hydrostatic pressure line, indicating pressures potentially higher than hydrostatic

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Comment 9. In the third item of Attachment A (Risk of Thin Gas Zones Present in the MRAA Aquitard), it is stated that “shallow gas wells are below hydrostatic pressure, the indoor air pathway is not complete, air entry pressures for Aquitard samples range from 7.8 psi for silts to over 100 psi for clays and silty clays, and that modeling of vertical gas migration through the Aquitard shows that gas could not have moved through the Aquitard in less than several decades even neglecting air entry pressure thresholds.”

For the statement that “shallow gas wells are below hydrostatic pressure”, please see Comment 5 for discussion of the pressures of shallow gas wells and other information relative to the occurrence of gas pressures exceeding the hydrostatic pressure of groundwater.

For the statement that “air entry pressures for Aquitard samples range from 7.8 psi for silts to over 100 psi for clays and silty clays”, the air entry pressure was not presented in the March 31, 2015 submittal. The air entry pressure data for the MRAA and aquitard soil samples was presented in the report dated April 3, 2015 titled *Compilation and Evaluation of Laboratory Analyses of Multiphase Flow Properties of Soil Samples from the MRAA and Overlying Strata, RRD-GAS-005* Submittal prepared by Tetra Tech. This report was submitted to LDNR/OC after the March 31, 2015 submittal (Recommendation for No Further Action Determination – East of Grand Bayou Area) and contains information to support the March 31, 2015 submittal.

The April 3, 2015 report presented capillary pressure test data for soil samples collected from the MRAA and the confining zone (aquitard) of the MRAA. The capillary pressure test data (water saturation and capillary pressure) were fitted to the soil-water characteristic curve equation based on theories of Fredlund and Xing and of Mualem and Van Genuchten (references are provided in the April 3, 2015 report). The air entry pressures (gas entry pressures) of the soil samples were then estimated from where the slopes of the characteristic curves intersected the value of 100% water saturation. The soil-water characteristic curves and estimated air entry pressures are included in Appendix E of the April 3, 2015 report. The soil laboratory data also included the saturated hydraulic conductivity of the soil.

CB&I reviewed the soil-water characteristic curves and compared the estimated air entry pressures to the measured soil saturated hydraulic conductivities and depths of the soil samples. Soil samples from the MRAA had the highest saturated hydraulic conductivities (1.4 to 8.4×10^{-3} centimeters per second, cm/sec) and air entry pressures ranging from 0.2 to 1.4 pounds per square inch (psi). Soil samples from the confining zone had hydraulic conductivities predominantly in the range of 1.15×10^{-6} to 7.68×10^{-4} cm/sec and air entry pressures ranging from 1.1 to 41.5 psi. Many of the soil samples from the confining zone had characteristic curves with limited capillary pressure data over a small range of water saturations and the air entry pressure was uncertain. The characteristic curves for confining zone soils with air entry pressures estimated at values greater than 8.6 psi had limited capillary pressure data (limited range of saturation values) and the extrapolation of the characteristic curve slope had greater uncertainty.

The two samples with the lowest hydraulic conductivities (7.7×10^{-7} and 3.5×10^{-8} cm/sec) had the highest air entry pressures of 85 and 112 psi, respectively. These soil samples had extremely limited capillary pressure data (limited range of capillary pressures and water saturations) and the capillary pressure-saturation data points did not clearly define the characteristic curves.

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CB&I recommends that TBC characterize the uncertainty of the air entry pressures to provide a better representation of the air entry pressures of the confining zone.

The confining zone beneath the Bayou Corne area is made up of discontinuous lenses and layers of interbedded clay, silt, and sand. Because of the discontinuous distribution of the soil types, it is unlikely that soil types with the highest air entry pressures could form a continuous horizontal barrier to eliminate the potential for vertical movement of gas. In addition, the continuity of soil types with higher air entry pressures can be interrupted by natural and artificial penetrations caused by the presence of sedimentary structures, plant matter (tree roots and trunks), compaction effects, drill holes, and other features.

For the statement that "modeling of vertical gas migration through the Aquitard shows that gas could not have moved through the Aquitard in less than several decades even neglecting air entry pressure thresholds", the third and last section of the March 31, 2015 submittal provides information on the gas modeling conducted by Tetra Tech and its results. The third section of the March 31, 2015 submittal is a report titled Analysis of Unsteady-State Flow of Gas through the Aquitard from the MRAA to Ground Surface at Bayou Corne, LA. This report describes unsteady-state modeling of vertical movement of gas in the confining zone of the MRAA. This document concluded that gas could not have moved through the aquitard (except through artificial penetrations) in the 2.5 years since the cavern breach.

The gas modeling is not based on actual site data representative of the site conditions controlling movement of gas. The gas modeling was conducted using a uniform value of saturated hydraulic conductivity of 1×10^{-8} cm/sec, which is less than the lowest hydraulic conductivity measured in the laboratory analyses of the soil samples (as reported in the April 3, 2015 report). The gas modeling did not incorporate the lithologic and soil properties data that has been acquired for the confining zone from the CPT investigations and laboratory testing program. It is recommended that the modeling be conducted using hydraulic conductivities and soil-water characteristic curves that are more representative of the site conditions. The model should be calibrated to site conditions including the observed discharge of thermogenic gas from bubble sites at the surface and excess gas pressure in the monitoring wells. In its current form, the gas model results cannot be used to support a determination of No Further Action in the area east of Grand Bayou.

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