

State of New Mexico  
Energy, Minerals and Natural Resources Department

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**Susana Martinez**  
Governor

**John Bemis**  
Cabinet Secretary

**Brett F. Woods, Ph.D.**  
Deputy Cabinet Secretary

**Jami Bailey**  
Division Director  
Oil Conservation Division



Paul Marken  
Completion Supervisor  
Referred to Dollie Busse  
**ConocoPhillips Company**  
San Juan Business Unit  
Phone: (505) 326-9837  
Email: [Dollie.L.Busse@conocophillips.com](mailto:Dollie.L.Busse@conocophillips.com)

July 9, 2012

Dear Ms. Busse,

The Oil Conservation Division ("Division") is in receipt of your request to beneficially use produced water to fracture treat the Horton #1B API # 30-045-35252, UL-I, Sec 35, Twn 32N, R11W. In granting this beneficial use the Division agrees and requires that:

1. The aquifer is an exempted aquifer because it does not currently serve as a source of drinking water, and that cannot now and will not in the foreseeable future serve as a source of drinking water because it is hydrocarbon producing. 19.15.2.7.E.5 NMAC
2. The water samples from the producing wells adjacent to Horton #1B have atypically low TDS for the San Juan Basin.
3. The produced water ConocoPhillips proposes to use for well stimulation averages less than 14,500 ppm TDS.
4. The produced water ConocoPhillips proposes to use in its pilot test is less than the TDS of the fluid used in a standard conventional well stimulation.
5. Notification is required to be given to the district office 24-72hrs prior to the commencement of hauling the produced water and shall include a schedule with beginning and ending dates.
6. All trucks hauling produced water to the location must have a copy of their approved C-133 and a copy of this letter in the truck.
7. This letter is to be in the trucks authorized to haul the produced water only for the time period supplied in the required notification.
8. Conoco is only authorized to haul water from downstream of the Vasely SWD #2 (API # 30-045-29936) second stage filtration system, which can be loaded into the trucks at the Vasely SWD #2 facility or the Mar Vista SWD #1 (API # 30-045-35126) facility.

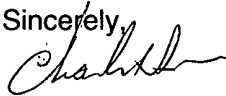
9. Conoco is required to keep a log of the loads of produced water taken to the location and have it available upon request.

10. This approval will expire on July 31<sup>st</sup>, 2012

If you have any further questions, please feel free to contact Brandon Powell at Brandon.Powell@state.nm.us or 505-334-6178 xt 116.

BP

Sincerely,



Charlie Perrin  
Aztec District Manager  
1000 Rio Brazos Road  
Aztec, NM 87410

RCVD JUL 2 '12  
OIL CONS. DIV.  
DIST. 3



San Juan

# Request for Alternative Use of Produced Water

*BP*

Horton #1B

API # 3004535252  
T32N R11W Sec 35 Unit I

June 27, 2012

Submitted by:

Paul Marken  
Completion Supervisor

*Paul R Marken* 6-28-2012

Kyle Hampton  
Completion Engineer

*Kyle Hampton* 6/28/2012

Please reply to: Dollie Busse at (505) 324-6104  
Or: [Dollie.L.Busse@conocophillips.com](mailto:Dollie.L.Busse@conocophillips.com)

## **Request for Alternative Use of Produced Water**

**1. COPC wishes to use 100% produced water as a base fluid for our stimulation of the Horton #1B. Plans are to use only this water to stimulate the Dakota, Mancos and Mesa Verde zones. The stimulation job will be completed no later than July 31, 2012. The legal description for the Horton #1B is as follows:**

**Location: 36° 56' 17.48"N 107° 57' 9.821" W : T32N R11W Sec 35 Unit I**

**API: 3004535252**

**2. The source of the produced water for this alternative use pilot test will be the Vasaly SWD #2. The water will be taken downstream from the second stage filtration, just upstream from the injection wellhead. This treated and filtered water will be transferred by pipeline to two 500 Bbl holding tanks located on the Mar Vista SWD #1 site. Vacuum trucks will then haul this water to the Horton #1B. This will be a mixture of produced water from Dakota, Mesa Verde, Pictured Cliffs and Fruitland formations. Historic water sample from the Vasaly SWD #2 have averaged less than 14,500 ppm TDS. Our standard stimulation fluid, 2% KCl, averages over 21,000 ppm TDS. Analysis of water from Vasaly SWD #2 sampled on 23 May 2012 is attached as Appendix A. The Vasaly SWD #2 is 100% owned by ConocoPhillips.**

**3. We do not anticipate any compatibility issues using water from Vasaly SWD #2 to fracture stimulate Horton #1B. The bulk of the water transported to Vasaly SWD #2 originates from the same formations we will be stimulating. API analyses of water from Vasaly SWD #2 indicate negligible scaling tendencies. Water samples from the State Com AJ#34 and State Com AK#35, which are near Horton #1B and are completed in the same target formation (Dk, MV) as Horton #1B, were analyzed for compatibility with the Vasaly SWD #2 water sample. The analysis was performed at three different mix ratios (25% / 75%, 50% / 50%, 75% / 25%). This analysis indicates negligible scaling tendencies at all mix ratios. These water sample analyses are attached in Appendix B.**

**4. A list of the wells disposing of water at the Vasaly SWD #2 is available on request.**

**5. We anticipate that we will use approximately 15,500 bbls of water to stimulate this well.**

**6. We will be storing the produced water on location in forty-two (42) 400 bbl frac tanks.**

**7. All fluids flowed back after the stimulation will be contained in a flowback tank, then transported to an approved disposal facility.**

# APPENDIX A

## Water Analysis Vasaly SWD #2

**Baker Hughes**

**Production Water Analysis for**

**ConocoPhillips FARMINGTON, Vasaly SWD #2 ,Drilling**

**Representative: Sheperd, Dave**

**Sample Date: 05/23/2012**

**Lab Test No: 2012115609**

|                          |             |            |
|--------------------------|-------------|------------|
| <b>Specific Gravity:</b> | 1.011       |            |
| <b>TDS:</b>              | 14876       |            |
| <b>pH:</b>               | 7.47        |            |
| <b>Cations</b>           | <b>mg/L</b> | <b>as:</b> |
| Calcium:                 | 87.03       | Ca         |
| Magnesium:               | 0           | Mg         |
| Sodium:                  | 4279        | Na         |
| Iron:                    | 25.97       | Fe         |
| Barium:                  | 3.41        | Ba         |
| Strontium:               | 14.44       | Sr         |
| Manganese:               | 0           | Mn         |
| <b>Anions</b>            | <b>mg/L</b> | <b>as:</b> |
| Bicarbonate:             | 1159        | HCO3       |
| Carbonate:               | 0           | CO3        |
| Sulfate:                 | 750         | SO4        |
| Chloride:                | 8500        | Cl         |
| <b>Gases:</b>            | <b>mg/L</b> | <b>as:</b> |
| Carbon Dioxide:          | 250         | CO2        |
| Hydrogen Sulfide:        | 17          | H2S        |
| <b>Lab Comments:</b>     |             |            |
| <b>Sales Comments:</b>   |             |            |

### **DownHole SAT Scale**

**Prediction:** 70

### **Saturation**

| <b>Mineral Scale</b> | <b>Index</b> | <b>Momentary Excess (lbs/1000 bbls)</b> |
|----------------------|--------------|-----------------------------------------|
| Calcite (CaCO3)      | 1.8          | 2.45                                    |
| Strontianite (SrCO3) | 1.27         | 1.36                                    |
| Anhydrite (CaSO4)    | 0.02         | -2759                                   |
| Gypsum (CaSO4*2H2O)  | 0.04         | -2260.45                                |
| Barite (BaSO4)       | 77.71        | 5.72                                    |
| Celestite (SrSO4)    | 0.17         | -134.82                                 |
| Siderite (FeCO3)     | 959.88       | 6.49                                    |
| Halite (NaCl)        | 0            | -491601.19                              |
| Iron sulfide (FeS)   | 1746.14      | 11.17                                   |

## APPENDIX B

### Water Analysis from adjacent producing wells

#### State Com AJ #34

##### Baker Hughes

##### Production Water Analysis for

ConocoPhillips FARMINGTON, State Com AJ #34 ,Drilling

Representative: Sheperd, Dave

Sample Date: 11/02/2011

Lab Test No: 2011132899

|                   |             |            |
|-------------------|-------------|------------|
| Specific Gravity: | 1.002       |            |
| TDS:              | 1047        |            |
| pH:               | 6.75        |            |
| <b>Cations</b>    | <b>mg/L</b> | <b>as:</b> |
| Calcium:          | 15.16       | Ca         |
| Magnesium:        | 0           | Mg         |
| Sodium:           | 260         | Na         |
| Iron:             | 0           | Fe         |
| Barium:           | 0           | Ba         |
| Strontium:        | 0           | Sr         |
| Manganese:        | 0           | Mn         |
| <b>Anions</b>     | <b>mg/L</b> | <b>as:</b> |
| Bicarbonate:      | 183         | HCO3       |
| Carbonate:        | 0           | CO3        |
| Sulfate:          | 7           | SO4        |
| Chloride:         | 520         | Cl         |
| <b>Gases:</b>     | <b>mg/L</b> | <b>as:</b> |
| Carbon Dioxide:   | 50          | CO2        |
| Hydrogen Sulfide: | 0           | H2S        |
| Lab Comments:     |             |            |
| Sales Comments:   |             |            |

|                                       |                         |                                         |
|---------------------------------------|-------------------------|-----------------------------------------|
| <b>DownHole SAT Scale Prediction:</b> | 180                     |                                         |
| <b>Mineral Scale</b>                  | <b>Saturation Index</b> | <b>Momentary Excess (lbs/1000 bbls)</b> |
| Calcite (CaCO3)                       | 0.14                    | -1.48                                   |
| Strontianite (SrCO3)                  | 0                       | -8.46                                   |
| Anhydrite (CaSO4)                     | 0                       | -745.65                                 |
| Gypsum (CaSO4*2H2O)                   | 0                       | -918.43                                 |
| Barite (BaSO4)                        | 0                       | -6.92                                   |
| Celestite (SrSO4)                     | 0                       | -186.15                                 |
| Siderite (FeCO3)                      | 0                       | -0.05                                   |
| Halite (NaCl)                         | 0                       | -477591.47                              |
| Iron sulfide (FeS)                    | 0                       | -0.58                                   |

## APPENDIX B

### Water Analysis from adjacent producing wells

#### State Com AK #35

##### Baker Hughes

##### Production Water Analysis for

ConocoPhillips FARMINGTON, State Com AK #35 ,Drilling

Representative: Sheperd, Dave

Sample Date: 11/02/2011

Lab Test No: 2011132898

|                   |             |            |
|-------------------|-------------|------------|
| Specific Gravity: | 1.003       |            |
| TDS:              | 2048        |            |
| pH:               | 6.59        |            |
| <b>Cations</b>    | <b>mg/L</b> | <b>as:</b> |
| Calcium:          | 15.69       | Ca         |
| Magnesium:        | 0           | Mg         |
| Sodium:           | 394         | Na         |
| Iron:             | 14.56       | Fe         |
| Barium:           | 0           | Ba         |
| Strontium:        | 0           | Sr         |
| Manganese:        | 0           | Mn         |
| <b>Anions</b>     | <b>mg/L</b> | <b>as:</b> |
| Bicarbonate:      | 427         | HCO3       |
| Carbonate:        | 0           | CO3        |
| Sulfate:          | 60          | SO4        |
| Chloride:         | 1020        | Cl         |
| <b>Gases:</b>     | <b>mg/L</b> | <b>as:</b> |
| Carbon Dioxide:   | 50          | CO2        |
| Hydrogen Sulfide: | 0           | H2S        |
| Lab Comments:     |             |            |
| Sales Comments:   |             |            |

|                                       |                         |                                         |
|---------------------------------------|-------------------------|-----------------------------------------|
| <b>DownHole SAT Scale Prediction:</b> | 180                     |                                         |
| <b>Mineral Scale</b>                  | <b>Saturation Index</b> | <b>Momentary Excess (lbs/1000 bbls)</b> |
| Calcite (CaCO3)                       | 0.16                    | -2.2                                    |
| Strontianite (SrCO3)                  | 0                       | -10.11                                  |
| Anhydrite (CaSO4)                     | 0                       | -874.95                                 |
| Gypsum (CaSO4*2H2O)                   | 0                       | -1081.12                                |
| Barite (BaSO4)                        | 0                       | -1.73                                   |
| Celestite (SrSO4)                     | 0                       | -186.77                                 |
| Siderite (FeCO3)                      | 591.14                  | 0.54                                    |
| Halite (NaCl)                         | 0                       | -502121.66                              |
| Iron sulfide (FeS)                    | 0                       | -0.06                                   |

## APPENDIX B

### Water Analysis from adjacent producing wells



#### DownHole SAT(tm) MIXED WATER DEPOSITION POTENTIAL INDICATORS

1) vasaaly swrd#2(25%)      2) state com AJ 34(75%)

Report Date: 11-10-2011

#### SATURATION LEVEL

|                                                  |         |
|--------------------------------------------------|---------|
| Calcite (CaCO <sub>3</sub> )                     | 0.105   |
| Aragonite (CaCO <sub>3</sub> )                   | 0.0865  |
| Witherite (BaCO <sub>3</sub> )                   | 0.00124 |
| Strontianite (SrCO <sub>3</sub> )                | 0.0120  |
| Magnesite (MgCO <sub>3</sub> )                   | 0.0213  |
| Anhydrite (CaSO <sub>4</sub> )                   | 0.00448 |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | 0.00508 |
| Barite (BaSO <sub>4</sub> )                      | 1.56    |
| Celestite (SrSO <sub>4</sub> )                   | 0.0101  |
| Fluorite (CaF <sub>2</sub> )                     | 0.00    |
| Calcium phosphate                                | 0.00    |
| Hydroxyapatite                                   | 0.00    |
| Silica (SiO <sub>2</sub> )                       | 0.00    |
| Brucite (Mg(OH) <sub>2</sub> )                   | < 0.001 |
| Magnesium silicate                               | 0.00    |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001 |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | 0.00    |
| Siderite (FeCO <sub>3</sub> )                    | 8.60    |
| Halite (NaCl)                                    | < 0.001 |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | < 0.001 |
| Iron sulfide (FeS)                               | 3.70    |

#### FREE ION MOMENTARY EXCESS (ppm)

|                                                  |          |
|--------------------------------------------------|----------|
| Calcite (CaCO <sub>3</sub> )                     | -2.11    |
| Aragonite (CaCO <sub>3</sub> )                   | -2.60    |
| Witherite (BaCO <sub>3</sub> )                   | -21.87   |
| Strontianite (SrCO <sub>3</sub> )                | -8.87    |
| Magnesite (MgCO <sub>3</sub> )                   | -6.10    |
| Anhydrite (CaSO <sub>4</sub> )                   | -1264    |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | -1337    |
| Barite (BaSO <sub>4</sub> )                      | 0.530    |
| Celestite (SrSO <sub>4</sub> )                   | -196.75  |
| Fluorite (CaF <sub>2</sub> )                     | -71.03   |
| Calcium phosphate                                | -0.00157 |
| Hydroxyapatite                                   | -799.21  |
| Silica (SiO <sub>2</sub> )                       | -302.56  |
| Brucite (Mg(OH) <sub>2</sub> )                   | -9.22    |
| Magnesium silicate                               | -647.16  |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001  |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | > 0.001  |
| Siderite (FeCO <sub>3</sub> )                    | 0.257    |
| Halite (NaCl)                                    | -500279  |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | -118577  |
| Iron sulfide (FeS)                               | 0.301    |

#### SIMPLE INDICES

|                    |        |
|--------------------|--------|
| Langelier          | -0.887 |
| Ryznar             | 8.27   |
| Puckorius          | 6.69   |
| Larson-Skold Index | 9.84   |
| Stiff Davis Index  | -0.569 |
| Oddo-Tomson        | -0.743 |

#### BOUND IONS

| BOUND IONS | TOTAL | FREE  |
|------------|-------|-------|
| Calcium    | 24.25 | 20.34 |
| Barium     | 0.875 | 0.875 |
| Carbonate  | 0.637 | 0.156 |
| Phosphate  | 0.00  | 0.00  |
| Sulfate    | 92.75 | 84.41 |

#### OPERATING CONDITIONS

|                  |        |
|------------------|--------|
| Temperature (°F) | 152.50 |
| Time(secs)       | 1.00   |

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P.O. Box 61427, Midland, Texas 79711

## APPENDIX B

### Water Analysis from adjacent producing wells



#### DownHole SAT(tm) MIXED WATER DEPOSITION POTENTIAL INDICATORS

1) vasaaly swd #2(50%)

2) state com AJ 34(50%)

Report Date: 11-10-2011

#### SATURATION LEVEL

|                                                  |         |
|--------------------------------------------------|---------|
| Calcite (CaCO <sub>3</sub> )                     | 0.0993  |
| Aragonite (CaCO <sub>3</sub> )                   | 0.0828  |
| Witherite (BaCO <sub>3</sub> )                   | 0.00189 |
| Strontianite (SrCO <sub>3</sub> )                | 0.0234  |
| Magnesite (MgCO <sub>3</sub> )                   | 0.0248  |
| Anhydrite (CaSO <sub>4</sub> )                   | 0.00578 |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | 0.00776 |
| Barite (BaSO <sub>4</sub> )                      | 6.79    |
| Celestite (SrSO <sub>4</sub> )                   | 0.0266  |
| Fluorite (CaF <sub>2</sub> )                     | 0.00    |
| Calcium phosphate                                | 0.00    |
| Hydroxyapatite                                   | 0.00    |
| Silica (SiO <sub>2</sub> )                       | 0.00    |
| Brucite (Mg(OH) <sub>2</sub> )                   | < 0.001 |
| Magnesium silicate                               | 0.00    |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001 |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | 0.00    |
| Siderite (FeCO <sub>3</sub> )                    | 9.98    |
| Halite (NaCl)                                    | < 0.001 |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | < 0.001 |
| Iron sulfide (FeS)                               | 5.14    |

#### FREE ION MOMENTARY EXCESS (ppm)

|                                                  |          |
|--------------------------------------------------|----------|
| Calcite (CaCO <sub>3</sub> )                     | -2.48    |
| Aragonite (CaCO <sub>3</sub> )                   | -3.00    |
| Witherite (BaCO <sub>3</sub> )                   | -25.73   |
| Strontianite (SrCO <sub>3</sub> )                | -8.04    |
| Magnesite (MgCO <sub>3</sub> )                   | -6.95    |
| Anhydrite (CaSO <sub>4</sub> )                   | -1787    |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | -1722    |
| Barite (BaSO <sub>4</sub> )                      | 2.53     |
| Celestite (SrSO <sub>4</sub> )                   | -196.70  |
| Fluorite (CaF <sub>2</sub> )                     | -70.27   |
| Calcium phosphate                                | -0.00158 |
| Hydroxyapatite                                   | -800.93  |
| Silica (SiO <sub>2</sub> )                       | -221.30  |
| Brucite (Mg(OH) <sub>2</sub> )                   | -8.34    |
| Magnesium silicate                               | -313.05  |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001  |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | >-0.001  |
| Siderite (FeCO <sub>3</sub> )                    | 0.291    |
| Halite (NaCl)                                    | -501000  |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | -129631  |
| Iron sulfide (FeS)                               | 0.584    |

#### SIMPLE INDICES

|                    |        |
|--------------------|--------|
| Langelier          | -0.915 |
| Ryznar             | 8.25   |
| Puckorius          | 6.35   |
| Larson-Skold Index | 11.71  |
| Stiff Davis Index  | -0.808 |
| Oddo-Tomson        | -0.943 |

#### BOUND IONS

| BOUND IONS | TOTAL  | FREE   |
|------------|--------|--------|
| Calcium    | 33.50  | 28.45  |
| Barium     | 1.75   | 1.75   |
| Carbonate  | 0.600  | 0.170  |
| Phosphate  | 0.00   | 0.00   |
| Sulfate    | 178.50 | 160.09 |

#### OPERATING CONDITIONS

|                  |        |
|------------------|--------|
| Temperature (°F) | 125.00 |
| Time(secs)       | 1.00   |

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## APPENDIX B

### Water Analysis from adjacent producing wells



#### DownHole SAT(tm) MIXED WATER DEPOSITION POTENTIAL INDICATORS

1) VASALY SWD#2(75%)      2) ST COM A3#34 (25%)

Report Date: 11-10-2011

| SATURATION LEVEL                                 |         | FREE ION MOMENTARY EXCESS (ppm)                  |          |
|--------------------------------------------------|---------|--------------------------------------------------|----------|
| Calcite (CaCO <sub>3</sub> )                     | 0.0880  | Calcite (CaCO <sub>3</sub> )                     | -2.88    |
| Aragonite (CaCO <sub>3</sub> )                   | 0.0746  | Aragonite (CaCO <sub>3</sub> )                   | -3.42    |
| Witherite (BaCO <sub>3</sub> )                   | 0.00222 | Witherite (BaCO <sub>3</sub> )                   | -28.90   |
| Strontianite (SrCO <sub>3</sub> )                | 0.0359  | Strontianite (SrCO <sub>3</sub> )                | -6.82    |
| Magnesite (MgCO <sub>3</sub> )                   | 0.0214  | Magnesite (MgCO <sub>3</sub> )                   | -8.68    |
| Anhydrite (CaSO <sub>4</sub> )                   | 0.00677 | Anhydrite (CaSO <sub>4</sub> )                   | -2287    |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | 0.00981 | Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | -2089    |
| Barite (BaSO <sub>4</sub> )                      | 20.04   | Barite (BaSO <sub>4</sub> )                      | 4.24     |
| Celestite (SrSO <sub>4</sub> )                   | 0.0453  | Celestite (SrSO <sub>4</sub> )                   | -194.43  |
| Fluorite (CaF <sub>2</sub> )                     | 0.00    | Fluorite (CaF <sub>2</sub> )                     | -67.09   |
| Calcium phosphate                                | 0.00    | Calcium phosphate                                | -0.00144 |
| Hydroxyapatite                                   | 0.00    | Hydroxyapatite                                   | -762.58  |
| Silica (SiO <sub>2</sub> )                       | 0.00    | Silica (SiO <sub>2</sub> )                       | -157.00  |
| Brucite (Mg(OH) <sub>2</sub> )                   | < 0.001 | Brucite (Mg(OH) <sub>2</sub> )                   | -7.45    |
| Magnesium silicate                               | 0.00    | Magnesium silicate                               | -283.92  |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001 | Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001  |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | 0.00    | Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | > 0.001  |
| Siderite (FeCO <sub>3</sub> )                    | 8.58    | Siderite (FeCO <sub>3</sub> )                    | 0.291    |
| Halite (NaCl)                                    | < 0.001 | Halite (NaCl)                                    | -492488  |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | < 0.001 | Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | -137952  |
| Iron sulfide (FeS)                               | 5.77    | Iron sulfide (FeS)                               | 0.826    |

| SIMPLE INDICES     |        | BOUND IONS | TOTAL  | FREE   |
|--------------------|--------|------------|--------|--------|
| Langelier          | -0.973 | Calcium    | 42.75  | 37.08  |
| Ryznar             | 8.32   | Barium     | 2.63   | 2.62   |
| Puckorius          | 6.20   | Carbonate  | 0.480  | 0.172  |
| Larson-Skold Index | 12.71  | Phosphate  | 0.00   | 0.00   |
| Stiff Davis Index  | -1.04  | Sulfate    | 264.25 | 235.88 |
| Oddo-Tomson        | -1.15  |            |        |        |

#### OPERATING CONDITIONS

Temperature (°F)      97.50  
Time(secs)      1.00

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## APPENDIX B

### Water Analysis from adjacent producing wells



#### DownHole SAT(tm) MIXED WATER DEPOSITION POTENTIAL INDICATORS

1) Vasaity swd#2(25%)

2) State com ak#35(75%)

Report Date: 11-10-2011

#### SATURATION LEVEL

|                                                         |         |
|---------------------------------------------------------|---------|
| Calcite ( $\text{CaCO}_3$ )                             | 0.144   |
| Aragonite ( $\text{CaCO}_3$ )                           | 0.118   |
| Witherite ( $\text{BaCO}_3$ )                           | 0.00174 |
| Strontianite ( $\text{SrCO}_3$ )                        | 0.0168  |
| Magnesite ( $\text{MgCO}_3$ )                           | 0.0280  |
| Anhydrite ( $\text{CaSO}_4$ )                           | 0.00533 |
| Gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ )    | 0.00604 |
| Barite ( $\text{BaSO}_4$ )                              | 1.90    |
| Celestite ( $\text{SrSO}_4$ )                           | 0.0123  |
| Fluorite ( $\text{CaF}_2$ )                             | 0.00    |
| Calcium phosphate                                       | 0.00    |
| Hydroxyapatite                                          | 0.00    |
| Silica ( $\text{SiO}_2$ )                               | 0.00    |
| Brucite ( $\text{Mg}(\text{OH})_2$ )                    | < 0.001 |
| Magnesium silicate                                      | 0.00    |
| Iron hydroxide ( $\text{Fe}(\text{OH})_3$ )             | < 0.001 |
| Strengite ( $\text{FePO}_4 \cdot 2\text{H}_2\text{O}$ ) | 0.00    |
| Siderite ( $\text{FeCO}_3$ )                            | 219.89  |
| Halite ( $\text{NaCl}$ )                                | < 0.001 |
| Thenardite ( $\text{Na}_2\text{SO}_4$ )                 | < 0.001 |
| Iron sulfide ( $\text{FeS}$ )                           | 55.23   |

#### FREE ION MOMENTARY EXCESS (ppm)

|                                                         |          |
|---------------------------------------------------------|----------|
| Calcite ( $\text{CaCO}_3$ )                             | -2.36    |
| Aragonite ( $\text{CaCO}_3$ )                           | -2.93    |
| Witherite ( $\text{BaCO}_3$ )                           | -23.36   |
| Strontianite ( $\text{SrCO}_3$ )                        | -9.50    |
| Magnesite ( $\text{MgCO}_3$ )                           | -6.83    |
| Anhydrite ( $\text{CaSO}_4$ )                           | -1338    |
| Gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ )    | -1416    |
| Barite ( $\text{BaSO}_4$ )                              | 0.704    |
| Celestite ( $\text{SrSO}_4$ )                           | -193.23  |
| Fluorite ( $\text{CaF}_2$ )                             | -74.34   |
| Calcium phosphate                                       | -0.00214 |
| Hydroxyapatite                                          | -842.13  |
| Silica ( $\text{SiO}_2$ )                               | -302.21  |
| Brucite ( $\text{Mg}(\text{OH})_2$ )                    | -9.71    |
| Magnesium silicate                                      | -664.32  |
| Iron hydroxide ( $\text{Fe}(\text{OH})_3$ )             | < 0.001  |
| Strengite ( $\text{FePO}_4 \cdot 2\text{H}_2\text{O}$ ) | > 0.001  |
| Siderite ( $\text{FeCO}_3$ )                            | 0.483    |
| Halite ( $\text{NaCl}$ )                                | -509370  |
| Thenardite ( $\text{Na}_2\text{SO}_4$ )                 | -123020  |
| Iron sulfide ( $\text{FeS}$ )                           | 6.30     |

#### SIMPLE INDICES

|                    |        |
|--------------------|--------|
| Langelier          | -0.723 |
| Ryznar             | 7.94   |
| Puckorius          | 6.05   |
| Larson-Skold Index | 7.65   |
| Stiff Davis Index  | -0.387 |
| Oddo-Tomson        | -0.600 |

#### BOUND IONS

| BOUND IONS | TOTAL  | FREE   |
|------------|--------|--------|
| Calcium    | 25.00  | 19.67  |
| Barium     | 0.875  | 0.875  |
| Carbonate  | 1.12   | 0.251  |
| Phosphate  | 0.00   | 0.00   |
| Sulfate    | 132.50 | 119.16 |

#### OPERATING CONDITIONS

|                  |        |
|------------------|--------|
| Temperature (°F) | 152.50 |
| Time(secs)       | 1.00   |

## APPENDIX B

### Water Analysis from adjacent producing wells



#### DownHole SAT(tm) MIXED WATER DEPOSITION POTENTIAL INDICATORS

1) vasa/y swd #2(50%)

2) st com ak#35(50%)

Report Date: 11-10-2011

| SATURATION LEVEL                                 |         | FREE ION MOMENTARY EXCESS (ppm)                  |          |        |
|--------------------------------------------------|---------|--------------------------------------------------|----------|--------|
| Calcite (CaCO <sub>3</sub> )                     | 0.121   | Calcite (CaCO <sub>3</sub> )                     | -2.58    |        |
| Aragonite (CaCO <sub>3</sub> )                   | 0.101   | Aragonite (CaCO <sub>3</sub> )                   | -3.14    |        |
| Witherite (BaCO <sub>3</sub> )                   | 0.00233 | Witherite (BaCO <sub>3</sub> )                   | -26.49   |        |
| Strontianite (SrCO <sub>3</sub> )                | 0.0288  | Strontianite (SrCO <sub>3</sub> )                | -8.30    |        |
| Magnesite (MgCO <sub>3</sub> )                   | 0.0300  | Magnesite (MgCO <sub>3</sub> )                   | -7.33    |        |
| Anhydrite (CaSO <sub>4</sub> )                   | 0.00614 | Anhydrite (CaSO <sub>4</sub> )                   | -1831    |        |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | 0.00823 | Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | -1765    |        |
| Barite (BaSO <sub>4</sub> )                      | 7.27    | Barite (BaSO <sub>4</sub> )                      | 2.56     |        |
| Celestite (SrSO <sub>4</sub> )                   | 0.0285  | Celestite (SrSO <sub>4</sub> )                   | -193.98  |        |
| Fluorite (CaF <sub>2</sub> )                     | 0.00    | Fluorite (CaF <sub>2</sub> )                     | -71.73   |        |
| Calcium phosphate                                | 0.00    | Calcium phosphate                                | -0.00180 |        |
| Hydroxyapatite                                   | 0.00    | Hydroxyapatite                                   | -819.38  |        |
| Silica (SiO <sub>2</sub> )                       | 0.00    | Silica (SiO <sub>2</sub> )                       | -221.13  |        |
| Brucite (Mg(OH) <sub>2</sub> )                   | < 0.001 | Brucite (Mg(OH) <sub>2</sub> )                   | -8.56    |        |
| Magnesium silicate                               | 0.00    | Magnesium silicate                               | -316.63  |        |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001 | Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001  |        |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | 0.00    | Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | >-0.001  |        |
| Siderite (FeCO <sub>3</sub> )                    | 82.83   | Siderite (FeCO <sub>3</sub> )                    | 0.425    |        |
| Halite (NaCl)                                    | < 0.001 | Halite (NaCl)                                    | -504828  |        |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | < 0.001 | Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | -131776  |        |
| Iron sulfide (FeS)                               | 32.99   | Iron sulfide (FeS)                               | 4.51     |        |
|                                                  |         |                                                  |          |        |
| SIMPLE INDICES                                   |         | BOUND IONS                                       | TOTAL    | FREE   |
| Langelier                                        | -0.815  | Calcium                                          | 34.00    | 28.13  |
| Ryznar                                           | 8.05    | Barium                                           | 1.75     | 1.75   |
| Puckorius                                        | 6.01    | Carbonate                                        | 0.809    | 0.223  |
| Larson-Skold Index                               | 10.07   | Phosphate                                        | 0.00     | 0.00   |
| Stiff Davis Index                                | -0.706  | Sulfate                                          | 205.00   | 182.74 |
| Oddo-Tomson                                      | -0.857  |                                                  |          |        |

#### OPERATING CONDITIONS

|                  |        |
|------------------|--------|
| Temperature (°F) | 125.00 |
| Time(secs)       | 1.00   |

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## APPENDIX B

### Water Analysis from adjacent producing



#### DownHole SAT(tm) MIXED WATER DEPOSITION POTENTIAL INDICATORS

1) vasaly swd#2(75%)      2) st com ak#35(25%)

Report Date: 11-10-2011

| SATURATION LEVEL                                 |         | FREE ION MOMENTARY EXCESS (ppm)                  |          |        |
|--------------------------------------------------|---------|--------------------------------------------------|----------|--------|
| Calcite (CaCO <sub>3</sub> )                     | 0.0964  | Calcite (CaCO <sub>3</sub> )                     | -2.92    |        |
| Aragonite (CaCO <sub>3</sub> )                   | 0.0818  | Aragonite (CaCO <sub>3</sub> )                   | -3.47    |        |
| Witherite (BaCO <sub>3</sub> )                   | 0.00243 | Witherite (BaCO <sub>3</sub> )                   | -29.22   |        |
| Strontianite (SrCO <sub>3</sub> )                | 0.0394  | Strontianite (SrCO <sub>3</sub> )                | -6.90    |        |
| Magnesite (MgCO <sub>3</sub> )                   | 0.0234  | Magnesite (MgCO <sub>3</sub> )                   | -8.84    |        |
| Anhydrite (CaSO <sub>4</sub> )                   | 0.00692 | Anhydrite (CaSO <sub>4</sub> )                   | -2287    |        |
| Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | 0.0100  | Gypsum (CaSO <sub>4</sub> *2H <sub>2</sub> O)    | -2107    |        |
| Barite (BaSO <sub>4</sub> )                      | 20.50   | Barite (BaSO <sub>4</sub> )                      | 4.24     |        |
| Celestite (SrSO <sub>4</sub> )                   | 0.0464  | Celestite (SrSO <sub>4</sub> )                   | -193.06  |        |
| Fluorite (CaF <sub>2</sub> )                     | 0.00    | Fluorite (CaF <sub>2</sub> )                     | -67.59   |        |
| Calcium phosphate                                | 0.00    | Calcium phosphate                                | -0.00151 |        |
| Hydroxyapatite                                   | 0.00    | Hydroxyapatite                                   | -768.93  |        |
| Silica (SiO <sub>2</sub> )                       | 0.00    | Silica (SiO <sub>2</sub> )                       | -156.94  |        |
| Brucite (Mg(OH) <sub>2</sub> )                   | < 0.001 | Brucite (Mg(OH) <sub>2</sub> )                   | -7.52    |        |
| Magnesium silicate                               | 0.00    | Magnesium silicate                               | -285.10  |        |
| Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001 | Iron hydroxide (Fe(OH) <sub>3</sub> )            | < 0.001  |        |
| Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | 0.00    | Strengite (FePO <sub>4</sub> *2H <sub>2</sub> O) | > -0.001 |        |
| Siderite (FeCO <sub>3</sub> )                    | 27.42   | Siderite (FeCO <sub>3</sub> )                    | 0.359    |        |
| Halite (NaCl)                                    | < 0.001 | Halite (NaCl)                                    | -493793  |        |
| Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | < 0.001 | Thenardite (Na <sub>2</sub> SO <sub>4</sub> )    | -138791  |        |
| Iron sulfide (FeS)                               | 16.68   | Iron sulfide (FeS)                               | 2.69     |        |
| SIMPLE INDICES                                   |         | BOUND IONS                                       | TOTAL    | FREE   |
| Langelier                                        | -0.929  | Calcium                                          | 43.00    | 36.99  |
| Ryznar                                           | 8.24    | Barium                                           | 2.63     | 2.62   |
| Puckorius                                        | 6.07    | Carbonate                                        | 0.543    | 0.193  |
| Larson-Skold Index                               | 11.89   | Phosphate                                        | 0.00     | 0.00   |
| Stiff Davis Index                                | -0.997  | Sulfate                                          | 277.50   | 247.09 |
| Oddo-Tomson                                      | -1.11   |                                                  |          |        |

#### OPERATING CONDITIONS

|                  |       |
|------------------|-------|
| Temperature (°F) | 97.50 |
| Time(secs)       | 1.00  |

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