STATE OF COLORADO
OIL & GAS
CONSERVATION COMMISSION

February 2, 2009

Certified Mail Return Receipt Requested # 7008 1140 0000 3926 4676

Mr. Jerry Angely
PO Box 1080
Walsenburg, CO 81089

RE: Complaint 200199690
Continued Monitoring – Groundwater Chemistry
NENW 10 29S, 67W Huerfano County, Colorado

Dear Jerry:

The COGCC collected water samples from your domestic well as part of continued monitoring of methane gas venting from your water well and elevated dissolved methane in the water produced from your well. Water samples were collected for general organic and inorganic water quality testing as well as for analysis of dissolved methane and volatile organic compounds. A summary of the results of the chemical analyses is presented below. The analytical results are also compared to published water quality standards and to results of prior testing of water from your well.

**FIELD TESTING**

Christa Whitmore of Whetstone Associates and Peter Gintautas of the COGCC visited your property on December 8, 2008. We started water flowing from an outdoor spigot at 11:20 at approximately 4.2 gallons per minute. Samples were collected at 11:58 after water temperature, conductivity and pH had been stable for twenty minutes. The table below includes the field sampling measurements as well as periodic measurements of depth to water before, during and after the sampling. The samples for general chemical analyses, dissolved methane and volatile organic compounds were then shipped to ALS Paragon in Fort Collins, CO and received on December 9, 2008. The samples for isotopic analysis were shipped to Isotech Laboratories in Champaign, IL and received on December 12, 2008.

| Date | Time | pH (s.u.) | Temperature (°C) | E.C. (µS/cm) | Disolved Oxygen (%) | Disolved Oxygen (mg/L) | Depth to Water (ft btoc) | Comments |
|---|---|---|---|---|---|---|---|---|
| 12/8/08 | 11:10 | --- | --- | --- | --- | --- | 513.19 | |
| 12/8/08 | 11:20 | --- | --- | --- | --- | --- | --- | Pump on |
| 12/8/08 | 11:25 | 7.93 | 17.4 | 1910 | 1.4% | 0.08 | --- | |
| 12/8/08 | 11:31 | --- | --- | --- | --- | --- | 574.59 | |
| 12/8/08 | 11:35 | 7.93 | 18.0 | 1930 | 0.5% | 0.05 | --- | |
| 12/8/08 | 11:41 | --- | --- | --- | --- | --- | ~602 | |
| 12/8/08 | 11:45 | 7.88 | 18.1 | 1949 | 0.4% | 0.03 | --- | |
| 12/8/08 | 11:51 | --- | --- | --- | --- | --- | --- | |
| 12/8/08 | 11:55 | 7.89 | 18.0 | 1943 | 0.5% | 0.04 | ~632.5 | |
| 12/8/08 | 11:58 | --- | --- | --- | --- | --- | --- | Sampled |
| 12/8/08 | 12:00 | --- | --- | --- | --- | --- | 647.31 | |
| 12/8/08 | 12:05 | --- | --- | --- | --- | --- | 646.5 | |
| 12/8/08 | 12:10 | --- | --- | --- | --- | --- | 641.15 | |
| 12/8/08 | 12:20 | --- | --- | --- | --- | --- | 634.81 | |

## COMPARISON OF INORGANIC ANALYTICAL RESULTS TO CDPHE INORGANIC STANDARDS

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) has established "Domestic Use-Quality" human health standards and drinking water standards. Analytical data for the samples from your water well was compared to these standards. This information is summarized in Table 1 which is located in Attachment 1 and discussed in narrative form below. Please keep in mind that these "Domestic Use-Quality Standards" were established for **municipal public** drinking water supplies and often people use and consume ground water from private wells that exceed these standards. The analytical reports from ALS Paragon are included as Attachment 2.

- **Antimony (Sb):** The CDPHE human health standard for antimony is 0.006mg/l. Antimony is a contaminate metal.

  Antimony was detected in the sample collected from your water well at a concentration of 0.00045mg/l which is below the CDPHE human health standard.

- **Arsenic (As):** The CDPHE human health standard for arsenic is 0.05 mg/l. Arsenic is a highly poisonous metal.

  Arsenic was not detected in the sample collected from your water well.

- **Barium (Ba):** The CDPHE human health standard for barium is 2.0 mg/l. Barium is a contaminate metal.

  Barium was not detected in the sample collected from your water well.

- **Beryllium (Be):** The CDPHE human health standard for beryllium is 0.004mg/l. Beryllium is a contaminate metal.

  Beryllium was not detected in the sample collected from your water well.

- **Cadmium (Cd):** The CDPHE human health standard for cadmium is 0.005 mg/l. Cadmium is a contaminate metal.

  Cadmium was not detected in the sample collected from your water well.

- **Chromium (Cr):** The CDPHE human health standard for chromium is 0.1 mg/l. Chromium is a contaminate metal.

  Chromium was not detected in the sample collected from your water well.

- **Lead (Pb):** The CDPHE human health standard for lead is 0.05 mg/l. Prolonged exposure to this metal can result in serious health effects.

  Lead was not detected in the sample collected from your water well.

- **Molybdenum (Mo):** The CDPHE human health standard for molybdenum in groundwater is 0.035mg/l.

  Molybdenum was detected in the sample collected from your water well at a concentration of 0.002mg/l which is below the CDPHE human health standard.

- **Nickel (Ni):** The CDPHE human health standard for nickel is 0.1mg/l. Nickel is a contaminate metal.

  Nickel was not detected in the sample collected from your water well.

- **Selenium (Se):** The CDPHE human health standard for selenium is 0.05 mg/l. Selenium is a contaminate metal.

  Selenium was not detected in the sample collected from your water well.

- **Silver (Ag):** The CDPHE human health standard for silver is 0.05 mg/l. Excess amounts of silver may cause a permanent gray discoloration of the skin.

  Silver was not detected in the sample collected from your water well.

- **Thallium (Tl):** The CDPHE human health standard for thallium is 0.002 mg/l. Thallium is a contaminate metal.

  Thallium was not detected in the sample collected from your water well.

- **Uranium (U):** The CDPHE human health standard for thallium is 0.03 mg/l. Uranium can be present due to erosion of natural deposits of this element.

  Uranium was not detected in the sample collected from your water well.

- **Fluoride (F)**: The CDPHE human health standard for fluoride is 4.0 mg/l. Where fluoride concentrations are in the range of 0.7 mg/l to 1.2 mg/l health benefits such as reduced dental decay have been observed. Consumption of fluoride at concentrations of greater than 2.0 mg/l can result in mottling of teeth. Consumption of fluoride at concentrations greater than 4.0 mg/l can increase the risk of skeletal fluorosis or other adverse health effects. Fluoride occurs naturally in the ground water in many areas in Colorado at concentrations that exceed the drinking water standard.

  Fluoride was detected in the sample collected from your water well at a concentration of 3.2mg/l which is below the CDPHE human health standard.

- **Nitrate ($NO_3$):** The CDPHE human health standard for nitrate is 10.0 mg/l. Nitrate can cause cyanosis in infants; a household water supply should not contain nitrate concentration in excess of 10 mg/l.

  Nitrate was not detected in the sample collected from your water well.

- **Nitrite ($NO_2$):** The CDPHE human health standard for nitrite is 1.0 mg/l. Nitrite concentrations exceeding 1.0 mg/l should not be used for feeding infants.

  Nitrite was not detected in the sample collected from your water well.

- **Copper (Cu):** The CDPHE secondary drinking water standard for copper is 1 mg/l.

  Copper was not detected in the sample collected from your water well.

- **Chloride (Cl):** The CDPHE secondary drinking water standard for chloride is 250mg/l. Chloride concentrations in excess of 250 mg/l usually produce a noticeable taste in drinking water.

  Chloride was detected in the sample collected from your water well at a concentration of 61mg/l which is below the CDPHE drinking water standard.

- **Iron (Fe):** The CDPHE secondary drinking water standard for iron is 0.3mg/l. Small amounts of iron are common in ground water. Iron produces a brownish-red color in laundered clothing, can leave reddish stains on fixtures, and impart a metallic taste to beverages and food made with it. After a period of time iron deposits can build up in pressure tanks, water heaters, and pipelines, reducing the effective flow rate and efficiency of the water supply.

  Iron was not detected in the sample collected from your water well.

- **Manganese (Mn):** The CDPHE secondary drinking water standard for manganese is 0.05mg/l. Manganese produces a brownish color in laundered clothing, may stain fixtures and affect the taste of coffee or tea.

  Manganese was detected in the sample collected from your water well at a concentration of 0.19mg/l which is above the CDPHE human health standard.

- **Sulfate ($SO_4$):** The CDPHE sulfate secondary standard for human drinking water is 250mg/l. Although CDPHE does not have an agricultural standard for sulfate, other agencies recommend a concentration below 1,500 mg/l for livestock watering. Waters containing high concentrations of sulfate, typically caused by the leaching of natural deposits of magnesium sulfate (Epsom salts) or sodium sulfate (Glauber's salt), may be undesirable because of their laxative effects.

  Sulfate was detected in the sample collected from your water well at a concentration of 1000mg/l which is above the CDPHE drinking water standard.

- **pH:** pH is the measure of the hydrogen ion concentration in water. The pH of water in its natural state is generally from 5.5 to 9.0. The CDPHE standard for domestic and agricultural water is a range of 6.5 to 8.5. Seven (7) represents neutrality, while values less than 7 indicate increasing acidity and values greater than 7 indicate increasing alkalinity.

  pH was measured in the water sample from your well with a value of 7.67 which is within the CDPHE drinking water and agricultural standards.

- **Total Dissolved Solids (TDS):** CDPHE's TDS standard for human drinking water is 500 milligrams per liter (mg/l). Although CDPHE does not have an agricultural standard for TDS, other agencies recommend concentrations below 1500 mg/l for irrigation, and below 5,000 mg/l for most livestock watering. TDS occurs naturally in the ground water in many areas of Colorado at concentrations that exceed the drinking water standard.

  TDS was measured in the water sample collected from your well at a concentration of 1600mg/l which is above the drinking water standard.

- **Zinc (Zn):** CDPHE's Zn standard for human drinking water is 5 milligrams per liter (mg/l) and the agricultural standard is 2mg/l.

  Zinc was not detected in the sample collected from your water well.

The following parameters were also measured as part of the laboratory analysis although there are no CDPHE standards.

- **Sodium (Na):** People on salt restricted diets should be aware of the sodium concentration in the water they drink. A concentration of less than 20 mg/l is recommended by some for people on salt restricted diets or

for people suffering from hypertension or heart disease. Sodium occurs naturally in the ground water in many areas of Colorado at concentrations that exceed this health advisory level.

Sodium was detected in the water sample from your well at a concentration of 260mg/l which is above the recommended level.

- **Boron (B):**

  The boron concentration in the sample collected from your water well was 0.45mg/l.

- **Calcium (Ca):**

  The calcium concentration in the sample collected from your well was 190mg/l.

- **Magnesium (Mg):**

  The magnesium concentration in the sample collected from your water well was 2.5.

- **Potassium (K):**

  The potassium concentration in the sample collected from your well was 2.2mg/l.

- **Bicarbonate ($HCO_3$):**

  Bicarbonate alkalinity was measured in the sample collected from your well at a concentration of 57mg/l.

- **Bromide (Br):**

  The bromide concentration in the sample collected from your well was 0.74mg/l.

**METHANE GAS ANALYSIS**

Methane was detected in the sample collected from your well at a concentration of 100mg/l. The reported concentration exceeds the solubility of methane in water at our elevation. The concentration of methane in the water produced from the well is above the threshold level of 1.1mg/l that could allow methane to accumulate in confined unventilated spaces and potentially be explosive. All samples from your well that I have a record of indicate the concentration of dissolved methane in water produced by your domestic well exceeds the 1.1mg/l threshold discussed above. The table below lists dates of sampling with associated reported concentrations of dissolved methane in water from your well. You have a vented outdoor cistern that serves as a passive treatment system to reduce methane dissolved in water pumped from your domestic well and then on to your home. I understand that you are not using water from the well in your house and that you are still relying on water deliveries arranged by Petroglyph for water used in your home. I would recommend that you continue to utilize water deliveries due to the high concentration of methane present in water produced by your well.

| Date Sampled | 12/17/2007 | 02/27/2008 | 3/26/2008 | 12/8/2008 (1st analysis) | 12/8/2008 (re-analysis) |
|---|---|---|---|---|---|
| methane (mg/l) | 23.2 | 0.11 | 15 | 100 | 29 |

I requested the laboratory to re-analyze the samples collected on December 8, 2008 for dissolved methane after the lab submitted the results to the COGCC due to the very high concentration reported.

The result of the re-analysis of the December 2008 samples is included in the table above. The relatively low concentration reported for the sample collected in February 2008 is thought to be artificially low due to a disinfection process carried out by Weber Water on your well after installation of a sounding tube between the December 2007 and February 2008 sampling events. The well was re-sampled in March 2008 after purging the well several times to remove the hypochlorite disinfectant that was left in the well per the well driller's and pump installer's rules.

## TOTAL EXTRACTABLE PETROLEUM HYDRCARBONS ANALYSES

Diesel range organic compounds (DRO) were not detected in the samples collected from your water well in December, 2008.

## SEMI-VOLATILE ORGANIC COMPOUND ANALYSES

The laboratory analyzed the samples collected in December, 2008 for the presence of 71 semi-volatile organic compounds. None of the 71 target compounds was detected in the sample.

## VOLATILE ORGANIC COMPOUND ANALYSES

The laboratory analyzed the samples collected in December, 2008 for the presence of 70volatile organic compounds. None of the 70 target compounds was detected in the sample.

## CONCLUSIONS

Table 1 in Attachment 1 compares the results of the most recent sampling and analysis event to the groundwater standards promulgated by the Water Quality Control Commission of the Colorado Department of Public Health and the Environment. All parameters tested are below the groundwater standards with the exception of TDS, sulfate and manganese. No standards exist for sodium, calcium or dissolved methane in groundwater or drinking water.

Table 2 in Attachment 4 compares general analytical results from samples collected since 2007 from your domestic water well. The analytical results shown in Table 2 indicate there have been significant changes in overall water chemistry since the December 2007 sampling event. The concentrations of sulfate, calcium and sodium in water produced by your well have increased significantly between December 2007 and December 2008. The pH has decreased by one unit. TDS has increased by a factor of 4. No other water well sampled in the area around your home has shown similar changes. That includes the wells installed by Petroglyph as part of the MIMMP pump, treat and re-inject system. I have examined all analytical data from the domestic wells as well as the treatment wells near your home and a summary of the major ion chemistry of all of those wells is presented as a Piper Diagram in Attachment 5.

A summary of the anion composition of the water produced by wells near yours is in the triangle in the lower right hand corner of the Piper diagram. Anions are negatively charged. Major anions in groundwater include sulfate, chloride as well as the sum of bicarbonate and carbonate which are from carbon dioxide dissolved in water. A summary of the cation composition of water produced by wells near yours is in the triangle in the lower left hand corner of the Piper diagram. Cations are positively charged. Major cations in grondwater include sodium, potassium, calcium and magnesium. The diamond in the center is a means to summarize the major anion and cation composition of waters in the vicinity of your well.

I labeled the points from your well with the year of collection. The composition of water from your well in 2007 sample plots in all three portions of the Piper diagram near the groundwater composition from other wells in the area. The composition of the sample collected in 2008 plot is very different than the

composition of the 2007 sample and is distinctly different from the composition of groundwater in other wells near your well. I do not know why these changes have taken place in water produced from your well. One possibility I have considered is that the hydrogen sulfide gas which has vented from your well along with methane is being oxidized to sulfate. This reaction can make the water more acidic. The pH of water from your well has decreased, which means the water is more acidic than it was previously even though it is still near neutral. The lower pH may then cause calcium carbonate minerals in the aquifer to dissolve which would lead to an increase in concentration of calcium in the groundwater. The lab did report significantly higher concentration of calcium in the water in December 2008 than in December 2009.

Significant changes in groundwater chemistry in a well can occur from changes in the source of the water. Testing of wells near yours has not shown any similar groundwater to that presently found in your well. The lack of any other well with similar chemistry to water from your well indicates to me the changes are part of processes that at present are unique to your well and I think the oxidation of hydrogen sulfide in your well to sulfate and hydrogen ion is a likely cause of the observed changes.

The isotopic composition of methane in groundwater from your well is thermogenic as shown in Attachment 6. The plot also includes analytical data from CBM wells and other water wells near your home. The isotopic composition of the methane venting from wells near your water well is similar to the isotopic composition of methane from your well. The isotopic ratios of deuterium and $^{13}C$ are similar to the ratios in methane from samples of Vermejo Formation gas.

If you have any questions or would like to discuss these matters further, please contact me at 719-846-3091 or by email at peter.gintautas@state.co.us . We appreciate your continued cooperation with the staff of the COGCC in granting continued access to sample and investigate the occurrence of methane in the Poison Canyon aquifer.

Sincerely,
Colorado Oil and Gas Conservation Commission

Peter Gintautas
Digitally signed by Peter Gintautas
DN: cn=Peter Gintautas, o=Colorado Oil and Gas Conservation Commission, ou, email=peter.gintautas@state.co.us, c=US
Date: 2009.02.02 10:56:15 -07'00'

Peter Gintautas
Environmental Protection Specialist

Attachments:
Attachment 1 - Table 1 - Analytical Summary
Attachment 2 - ALS Paragon Reports
Attachment 3 - Isotech Laboratories Report
Attachment 4 - Table 2 - Summary of 2007-2008 Analytical Results
Attachment 5 - Piper Diagram
Atatchment 6 - Plot of Isotopic Composition of Methane

cc: David Neslin, Acting COGCC Director w/o attachments
Debbie Baldwin, COGCC Environmental Protection Manager w/o attachments
Margaret Ash, COGCC Environmental Protection Supervisor w/o attachments
Tom Melland, Petroglyph w/o attachments

**TABLE 1**
**ANALYTICAL SUMMARY**
**Complaint 200199690**
**Angely Water Well**

| Parameter | Water Sample | | CDPHE Standards | | |
|---|---|---|---|---|---|
| | Sample Date | | | | |
| | 08-Dec-08 | | | | |
| | Result | Unit | Domestic | Agriculture | Units |
| Antimony | 0.00045 | mg/l | 0.006 | NS | mg/l |
| Arsenic | ND | mg/l | 0.01 | 0.1 | mg/l |
| Barium | ND | mg/l | 2.0 | NS | mg/l |
| Berylium | ND | mg/l | 0.004 | 0.1 | mg/l |
| Boron | 0.45 | mg/l | NS | 0.75 | mg/l |
| Cadmium | ND | mg/l | 0.005 | 0.01 | mg/l |
| Calcium | 190 | mg/l | NS | NS | |
| Chromium | ND | mg/l | 0.1 | 0.1 | mg/l |
| Cobalt | ND | mg/l | NS | 0.05 | mg/l |
| Copper | ND | mg/l | 1 | 0.2 | mg/l |
| Iron | ND | mg/l | 0.3 | 5 | mg/l |
| Lead | ND | mg/l | 0.05 | 0.1 | mg/l |
| Lithium | 0.029 | mg/l | NS | NS | |
| Magnesium | 2.5 | mg/l | NS | NS | |
| Manganese | 0.19 | mg/l | 0.05 | 0.2 | mg/l |
| Molybdenum | 0.002 | mg/l | 0.035 | NS | mg/l |
| Nickel | ND | mg/l | 0.1 | 0.2 | mg/l |
| Potassium | 2.2 | mg/l | NS | NS | |
| Selenium | ND | mg/l | 0.05 | 0.02 | mg/l |
| Silver | ND | mg/l | 0.05 | NS | mg/l |
| Sodium | 260 | mg/l | NS | NS | |
| Strontium | 3.8 | mg/l | NS | NS | |
| Thallium | ND | mg/l | 0.002 | NS | mg/l |
| Uranium | ND | mg/l | 0.03 | NS | mg/l |
| Zinc | ND | mg/l | 5 | 2 | mg/l |
| Chloride | 61 | mg/l | 250 | NS | mg/l |
| Nitrite | ND | mg/l | 1.0 | 10 | mg/l |
| Nitrate | ND | mg/l | 10.0 | 100 | mg/l |
| Total Nitrite/Nitrate | ND | mg/l | 10.0 | 100 | mg/l |
| Fluoride | 3.2 | mg/l | 4.0 | NS | mg/l |
| Total Dissolved Solids | 1600 | mg/l | 400 | *1500 | mg/l |
| pH | 7.67 | No units | 6.5 - 8.5 | 6.5 - 8.5 | No units |
| Sulfate | 1000 | mg/l | 250 | NS | mg/l |
| Bromide | 0.74 | mg/l | NS | NS | |
| Total Alkalinity | 57 | mg/l | NS | NS | |
| Bicarbonate | 57 | mg/l | NS | NS | |
| Carbonate | ND | mg/l | NS | NS | |
| Conductivity | 2040 | umhos/cm | NS | NS | |
| methane | 100 | mg/l | NS | NS | |
| Total Organic Carbon | 1.6 | mg/l | NS | NS | |

**Notes**

| | |
|---|---|
| **CDPHE** | Colorado Department of Public Health and the Environment. |
| **Domestic** | Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards For Groundwater. |
| **Agriculture** | * Standards for agriculture complied from CDPHE and other of sources. |
| **mg/l** | milligrams per liter (ppm or parts per million). |
| **µmhos/cm** | micromhos per centimeter |
| **NA** | Not analyzed. |
| **ND** | Not detected. |
| **NS** | No Standard. |
| ****** | Health Advisory. |
| | Human health standard. |
| | Secondardy standard. |

ISOTECH
ISOTECH LABORATORIES INC

# ANALYSIS REPORT

| | | | |
|---|---|---|---|
| Lab #: | 151580 | Job #: | 10746 |
| Sample Name/Number: | Angely WW | | |
| Company: | Colorado Oil & Gas Conservation | | |
| Date Sampled: | 12/08/2008 | | |
| Container: | Dissolved Gas Bottle | | |
| Field/Site Name: | Complaint 200199690 | | |
| Location: | Huerfano County, CO | | |
| Formation/Depth: | | | |
| Sampling Point: | | | |
| Date Received: | 12/12/2008 | Date Reported: | 12/31/2008 |

| Component | Chemical mol. % | Delta 13C per mil | Delta D per mil | Delta 18O per mil |
|---|---|---|---|---|
| Hydrogen Sulfide | nd | | | |
| Helium | nd | | | |
| Hydrogen | nd | | | |
| Argon | 0.229 | | | |
| Oxygen | 2.19 | | | |
| Nitrogen | 10.47 | | | |
| Carbon Dioxide | 0.097 | | | |
| Methane | 86.96 | -49.28 | -235.4 | |
| Ethane | 0.0532 | | | |
| Ethylene | na | | | |
| Propane | nd | | | |
| Iso-butane | nd | | | |
| N-butane | nd | | | |
| Iso-pentane | nd | | | |
| N-pentane | nd | | | |
| Hexanes + | nd | | | |
| Water | | | -104.3 | -13.87 |
| Dissolved Inorganic Carbon | | -22.14 | | |

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 882 Specific gravity, calculated: 0.612

Remarks: Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.46

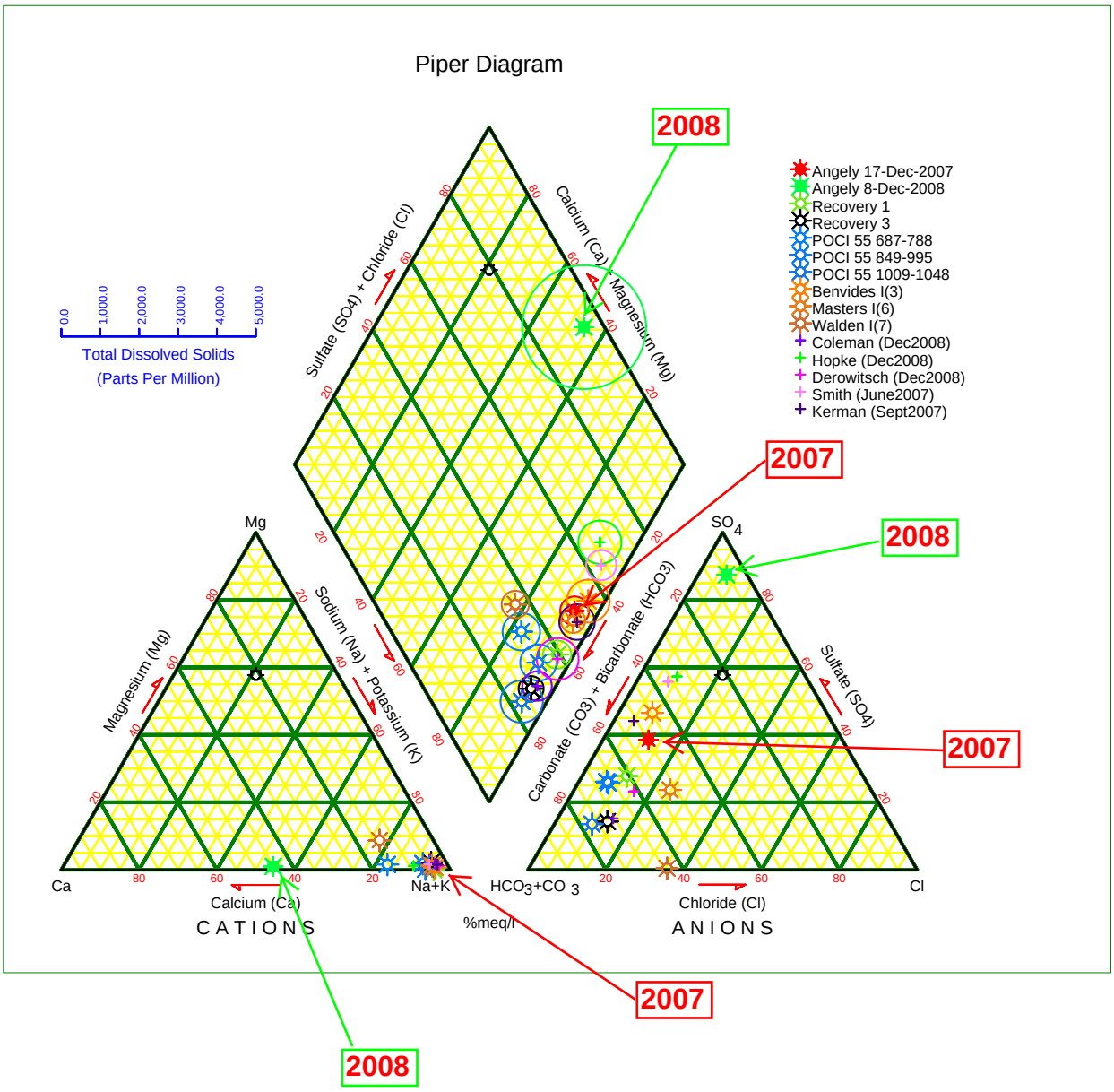
nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen and oxygen are relative to VSMOW. Calculations for BTU and specific gravity per D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %. ASTM Chemical analysis based on standards accurate to within 2%

**TABLE 2**
**ANALYTICAL SUMMARY 2007 to 2008**
**Complaint 200199690**
**Angely Water Well**

| Parameter | Water Sample | | | CDPHE Standards | | |
|---|---|---|---|---|---|---|
| | Sample Date | Sample Date | | | | |
| | 17-Dec-07 | 08-Dec-08 | | | | |
| | Result | Result | Unit | Domestic | Agriculture | Units |
| Antimony | 0.00031 | 0.00045 | mg/l | 0.006 | NS | mg/l |
| Arsenic | ND | ND | mg/l | 0.01 | 0.1 | mg/l |
| Barium | ND | ND | mg/l | 2.0 | NS | mg/l |
| Berylium | ND | ND | mg/l | 0.004 | 0.1 | mg/l |
| Boron | ND(<0.1) | 0.45 | mg/l | NS | 0.75 | mg/l |
| Cadmium | ND | ND | mg/l | 0.005 | 0.01 | mg/l |
| Calcium | 4 | 190 | mg/l | NS | NS | |
| Chromium | ND | ND | mg/l | 0.1 | 0.1 | mg/l |
| Cobalt | NA | ND | mg/l | NS | 0.05 | mg/l |
| Copper | ND | ND | mg/l | 1 | 0.2 | mg/l |
| Iron | ND | ND | mg/l | 0.3 | 5 | mg/l |
| Lead | ND | ND | mg/l | 0.05 | 0.1 | mg/l |
| Lithium | NA | 0.029 | mg/l | NS | NS | |
| Magnesium | ND (<1) | 2.5 | mg/l | NS | NS | |
| Manganese | ND(<0.01) | 0.19 | mg/l | 0.05 | 0.2 | mg/l |
| Molybdenum | 0.0038 | 0.002 | mg/l | 0.035 | NS | mg/l |
| Nickel | ND | ND | mg/l | 0.1 | 0.2 | mg/l |
| Potassium | ND(<1) | 2.2 | mg/l | NS | NS | |
| Selenium | ND | ND | mg/l | 0.05 | 0.02 | mg/l |
| Silver | ND | ND | mg/l | 0.05 | NS | mg/l |
| Sodium | 95 | 260 | mg/l | NS | NS | |
| Strontium | 0.12 | 3.8 | mg/l | NS | NS | |
| Thallium | ND | ND | mg/l | 0.002 | NS | mg/l |
| Uranium | NA | ND | mg/l | 0.03 | NS | mg/l |
| Zinc | ND | ND | mg/l | 5 | 2 | mg/l |
| Chloride | 21 | 61 | mg/l | 250 | NS | mg/l |
| Nitrite | ND | ND | mg/l | 1.0 | 10 | mg/l |
| Nitrate | ND | ND | mg/l | 10.0 | 100 | mg/l |
| Total Nitrite/Nitrate | ND | ND | mg/l | 10.0 | 100 | mg/l |
| Fluoride | 9.8 | 3.2 | mg/l | 4.0 | NS | mg/l |
| Total Dissolved Solids | 300 | 1600 | mg/l | 400 | *1500 | mg/l |
| pH | 8.76 | 7.67 | No units | 6.5 - 8.5 | 6.5 - 8.5 | No units |
| Sulfate | 94 | 1000 | mg/l | 250 | NS | mg/l |
| Bromide | ND (<0.2) | 0.74 | mg/l | NS | NS | |
| Total Alkalinity | 110 | 57 | mg/l | NS | NS | |
| Bicarbonate | 89 | 57 | mg/l | NS | NS | |
| Carbonate | 17 | ND | mg/l | NS | NS | |
| Conductivity | 507 | 2040 | umhos/cm | NS | NS | |
| methane | 23.2 | 100 | mg/l | NS | NS | |
| Total Organic Carbon | NA | 1.6 | mg/l | NS | NS | |

**Notes**

| | |
|---|---|
| **CDPHE** | Colorado Department of Public Health and the Environment. |
| **Domestic** | Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards |
| **Agriculture** | * Standards for agriculture complied from CDPHE and other of source |
| **mg/l** | milligrams per liter (ppm or parts per million). |
| **µmhos/cm** | micromhos per centimeter |
| **NA** | Not analyzed. |
| **ND** | Not detected. |
| **NS** | No Standard. |
| ****** | Health Advisory. |
| | Human health standard. |
| | Secondardy standard. |


Piper Diagram
2008
2007
2008
2007
2007
2008
Angely 17-Dec-2007
Angely 8-Dec-2008
Recovery 1
Recovery 3
POCl 55 687-788
POCl 55 849-995
POCl 55 1009-1048
Benvides I(3)
Masters I(6)
Walden I(7)
Coleman (Dec2008)
Hopke (Dec2008)
Derowitsch (Dec2008)
Smith (June2007)
Kerman (Sept2007)
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
Total Dissolved Solids
(Parts Per Million)
Sulfate (SO4) + Chloride (Cl)
Calcium (Ca)
Magnesium (Mg)
Mg
Magnesium (Mg)
Sodium (Na) + Potassium (K)
Ca
Calcium (Ca)
Na+K
CATIONS
%meq/l
SO 4
Carbonate (CO3) + Bicarbonate (HCO3)
Sulfate (SO4)
HCO3+CO 3
Chloride (Cl)
Cl
ANIONS

**Typical Compositional Ranges of Methanes from Different Sources in Huerfano Countiy**