SIGNER WATER WELL COMPLAINT REVIEW

Prepared by:
Alexander Blyth, P.Geol., Ph.D.

Alberta Research Council Inc.
Permit to Practice P03619

Prepared for:

Alberta Environment
10th Floor Oxbridge Place
9820 - 106 Street
Edmonton, Alberta T5K 2J6

December 31, 2007

Contact Information:
Alec Blyth
Alberta Research Council Inc.
3608 – 33 Street NW
Calgary, Alberta T2L 2A6
Phone: 403-210-5345
E-mail: blyth@arc.ab.ca

EXECUTIVE SUMMARY

In September of 2004 Ms. Signer initiated a complaint of increased methane in her well with EnCana. EnCana's consultant initiated a well investigation on September 2004 and AENV initiated a well investigation in May 2006. In November, 2007, Alberta Research Council (ARC) was contracted by AENV to critically review the scientific and technical data contained in the AENV Signer water well complaint file. In addition, ARC was asked to do an independent review of all relevant data, including new data that has become available through Directive 35 (Standard Baseline Water-Well Testing for CBM/NGC Operations) and other information in the EUB files.

ARC's independent review and evaluation involved the examination of all the data contained in the AENV file and the following additional lines of evidence:

- Review of the local and regional geology and hydrostratigraphy.
- Calculation of hydraulic gradients between the aquifer in the Upper Horseshoe Canyon Formation and the CBM wells.
- A theoretical review of the potential of methane migration along a fracture (potentially induced by well stimulation) between the Horseshoe Canyon aquifer and the CBM well using the observed pressure gradients.
- An estimation of the change in dissolved methane concentrations in the Signer well related to the fluctuations in water level observed in the Signer well.
- A graphical and statistical approach to the evaluation of the major ions, bacteria, gas and isotope chemistry of the Signer well, 145 surrounding water wells from the AENV database and CBM wells in the area.

Alberta Research Council's overall conclusion of the evidence from the review of the AENV and AEUB files, along with a new review and evaluation of additional data and concepts, is that energy development projects in the area most likely had no adverse affects on Ms. Signer's water well.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Alberta Research Council (ARC) was contracted by Alberta Environment (AENV) to conduct a review of the technical and scientific data on the subject of a complaint placed by landowner Ms. Debbie Signer, located SE-10-027-22 W4M, near Redland, Alberta. The complaint was about Coal Bed Methane (CBM) activities undertaken by EnCana Corporation and her concerns about the presence of increased methane gas in her water well and an associated decrease in water quality. Historically, methane has been observed in water wells in the Rosebud and Redland areas. This is an expected occurrence because most water wells in the area are completed in coal that can contain methane. The complaint concerned whether CBM activities in the area have increased the amount of methane in the Signer well. ARC undertook this review to assess whether the evidence suggests that energy resource extraction operations have impacted the water quality on the landowner's property through the migration of methane from energy wells to the water well. ARC agreed to work under contract to AENV to independently assess the situation and provide conclusions identifying whether or not the AENV investigation suggests groundwater has been impacted by CBM or conventional oil/gas extraction activities in the area.

This report summarizes ARC's independent conclusions based on scientific and technical data surrounding the investigation of the complaint. The review is based primarily on the collected information in AENV's water well complaint file. Available scientific and technical data include groundwater quality data, water well construction characteristics, oil and gas production activities, and local groundwater gas characteristics. In addition, ARC endeavoured to compile, review and assess supplementary information not included within the complaint file. This supplementary information includes results of an evaluation of CBM Baseline water well testing data in the general area (provided by AENV and WorleyParsons Komex), EUB information on energy wells, digital elevation maps and a geological cross section of the area constructed by ARC.

2 REGIONAL GEOLOGIC AND HYDROGEOLOGIC SETTING

2.1 Stratigraphy

The study area is found within the Alberta Basin. A complete review of the geology of the basin is provided in Mossop and Shetsen (1994). A brief overview is given below. The Alberta basin originated in the late Proterozoic by rifting of the North American craton and early sedimentary deposition was dominated by carbonates, evaporates and shale. Uplift of the Rocky Mountains in the early Cretaceous deposited fluvial sandstones and shales into the developing foreland basin. The changing sea levels during the middle to late Cretaceous resulted in deposition of marine shale and coal-bearing fluvial sandstone. Peat accumulation provided the source material for the major coal-bearing strata including the Manville Group, Belly River Group and Edmonton Group (the latter includes the Horseshoe Canyon Formation). The latter two groups are where the EnCana CBM wells are completed. A period of compression and uplift in the Tertiary led to the deposition of fluvial sandstone, siltstone and shale. Peat accumulation

provided the source material for the coals in the Cretaceous/Tertiary Scollard Formation and the Tertiary Paskapoo Formation. Glaciation during the Quaternary eroded the bedrock and deposited unconsolidated sediments on the bedrock. Descriptions of the geology from older to younger that are encountered in the area of investigation are as follows:

Belly River Group
The deepest geological unit penetrated by the EnCana CBM wells is the Belly River Group. The upper part (Oldman Formation) of the Belly River Group consists of sandstones, siltstones and coal (Lethbridge) deposited in a floodplain and lacustrian environment (Beaton et al. 2002).

Bearpaw Formation
A marine transgression deposited fine-grained marine sediments of the Bearpaw Formation directly onto the Belly River Group. These sediments are predominantly shale and siltstone, with some sandstone beds and claystone (Macdonald et al. 1987).

Edmonton Group
The Edmonton group is comprised of four formations, from oldest to youngest: the Horseshoe Canyon Formation, the Whitemud Formation, The Battle Formation and the Scollard Formation. Only the Horseshoe Canyon is present in the study area. The Horseshow Canyon formation consists of shale, siltstone and coal members (Basal, Rockyford, Drumheller, and Weaver), deposited in deltaic and fluvial environments (Beaton et al 2002). In the area, the Horseshoe Canyon Formation is covered by Late Tertiary–Quaternary unconsolidated sediments or till.

2.2 Regional Stress Regime

The stress regime of upper Cretaceous – Tertiary coal-bearing strata in Alberta has a strong correlation to permeability and fracture directions in coal (face cleats). This in turn has a strong control on the direction that “fluids” (both gas and water) tend to migrate in these strata. Rock mechanics theory and field measurements shows that fractures trend in a direction normal to the least compressive stress. Horizontal stress orientations in Alberta have been measured using well breakout analyses (i.e. damage to boreholes caused by stresses acting on the rock) (Bachu and Michael 2002). Based on breakout analysis the most likely azimuth (orientation) of fractures and face cleats in the coal would be about 055°E of N. No energy wells (within 2 km) line up on the 055° azimuth to the Signer well.

2.3 Hydrostratigraphy and Groundwater Flow and Gradients

Regional flow systems across the Alberta Basin are controlled in part by major recharge areas along the Rocky Mountain front in western Alberta. Regional flow within the basin is northeast towards the basin edge (Hitcheon 1969a,b). Bachu (1999) recognised that flow in the northern part of the basin was driven by topography north-eastward, however, flow in Upper Cretaceous rocks in the south-western part of the basin (including the study area) was directed south-westward, driven by erosional rebound due to stripping of up to 3800m of sediments (Parks, and

Tóth 1995; Bachu 1999). Regionally, the Horseshoe Canyon Formation acts as an aquifer above the Bearpaw Formation aquitard. Below the Bearpaw, the upper Belly River Formation acts as an aquifer.

In the Redland area shallow groundwater flow within the overburden is directed towards the Rosebud River. Regional groundwater flow in the Upper Horseshoe Canyon aquifer (Carbon Thompson and Weaver coals where most domestic wells including the Signer well are completed) is directed to the northeast (Bachu and Michael 2002). Hydraulic conductivities of the rock are expected to be low to intermediate and yields from wells in this area are expected to be 1 to 5 imperial gallons per minute (Borneuf 1972). The Signer well was tested at between 0.7 and 2.4 imperial gallons per minute and had an estimated average hydraulic conductivity of $2x10^{-6}$ m/s as estimated by ARC from the available pumping test data.

In the deeper (below 200 m) Horseshoe Canyon Formation groundwater flow is also directed to the northeast. Permeability data for the coal zones are not well reported in the literature. However, it is expected that permeability of the coal decreases with depth of burial. Unpublished data referred to by Bachu and Michael (2002) indicates permeabilities for deep coals on the order of a few mD (millidarcy) which indicates very low primary permeability. Completion data from the EnCana wells in the area suggest that the coals (with the exception of the upper Carbon Thompson and Weaver members of the Horseshoe Canyon) are not water saturated based on pressure measurements and water production data.

Regionally groundwater flow in the Belly River aquifer is directed to the southwest due to erosional uplift (Parks and Tóth 1995; Bachu 1999). Coal permeability is expected to be on the order of a few mD, similar to that in the overlying Horseshoe Canyon coals. Completion data from the EnCana wells in the area show that the coals are not water saturated. The implication of this is that hydrocarbon gases are not expected to be transported from the deep (gas saturated) coals to the shallow (water saturated) coals in a dissolved state.

Large downward vertical gradients between the upper Horseshoe Canyon aquifer (where the Signer well is completed) and the deeper Horseshoe Canyon coals (Drumheller member and below) are expected and calculated (see section 4.4.2). The Horseshoe Canyon and Belly River coal zones are underpressured (or lower) with respect to predicted hydraulic gradients based on elevation differences. These lower pressures have been interpreted to be due to erosional rebound caused by stripping of up to 3800m of sediments (Parks. and Tóth, 1995; Bachu 1999).

3 ENERGY WELL INFORMATION

A map of the energy wells within a minimum 1.5 km radius of the Signer well is shown on Figure 1. A list of gas well information (including the drilling date, loss of circulation, surface casing depth, total depth, cement returns and perforations) was supplied to AENV by EnCana (Appendix A). More detailed information was gathered on several wells in the area because of their proximity (<800 m) from the Signer well and a specific well of concern, identified by Ms.

Signer, with perforation depths of 125.5 m. A review of the tour reports was provided by Brenda Austin of the AEUB (Table 1). All depths on the table are mKb (metres from the Kelly bushing which is usually 3 to 4 metres above ground surface) except that ARC has added the elevation (metres above seal level) of the upper perforations in the energy well from AEUB and EnCana records. The four energy wells in closest proximity (<800 m) to the Signer water well and the specific CBM well (00/05-14-027-22 W4M) that had shallow perforations are discussed below. Compositional and/or isotopic data was available for some of these energy wells in the vicinity of the Signer well and is discussed in section 4 of this report.

The closest energy wells to the Signer well are 00/04-11-27-22W4M and 02/04-11-27-22W4M and are both approximately 750 m to the south. The 00/04-11-27-22W4M well is completed in the Edmonton, Belly River, Viking and Manville Formations with uppermost perforations from 616.5 to 619.5 mKb (metres from the Kelly bushing which is usually 3 to 4 metres above ground surface) in October 1997. Circulation was lost during the drilling of the surface casing between 12 and 31 m due to gravel in the overburden material above the bedrock. This is the sandy gravel that was encountered during the drilling of the GOWN well in the area and also noted on several water well drilling records in the area. Circulation control was regained by adding bentonite and lime to the drilling fluids. The surface casing was cemented with good returns to the surface noted. It is unlikely that this circulation loss in the overburden could have affected the Signer well which is 750 m to the north and completed in bedrock at about 60 m. AEUB records show that since 2000 this conventional gas well produces 0 to 8.8 m^3 of water per month, with a cumulative water production of 74 m^3.

The 02/04-11-27-22W4M well is completed in the Edmonton (Horseshoe Canyon) Formation with uppermost perforations from 190.5 to 191.5 mKb and was drilled in January 2004. Well stimulation was done using 100% nitrogen gas. The well had good cement returns on the surface and production casings. There are no apparent drilling and construction issues with this well. Since 2004 this gas well produces 0 to 3.6 m^3 of water per month, with a cumulative water production of 19.5 m^3. The water is likely coming from the coal and from condensation of water in the gas.

The EnCana energy well 00/07-11-27-22W4M/3 is located approximately 1.2 km to the east of the Signer well. This well was originally completed in the Basal Belly River Formation, Viking & Manville formations with perforations from 1188.5 to 1191.5, 636 to 639 and 604 to 607 mKb. Conventional gas was produced from the two lower perforations. The lower zones were abandoned with a bridge plug and capped with cement in April 2005 and the well was re-completed in the Horseshoe Canyon Formation with the upper perforation between 175.9 to 177.0 mKb. Well stimulation was done using 100% nitrogen gas. AEUB records show that since 2005 this well produces 0 to 1.3 m^3 of water per month, and to-date has a cumulative water production of less than 4 m^3. This is a relatively small amount of water that is likely coming from the coal and from condensation of water vapour with the gas. No lost circulation was reported for this well and both the surface and production casings had good cement returns. This information does not indicate any apparent drilling and construction issues with this well.

EnCana CBM well 00/05-14-027-22 W4M, located about 1.7 km north of the Signer well, was drilled October 13, 2003, perforated February 15, 2004 and nitrogen fractured on March 2, 2004. The top perforation was stimulated with 3,000 m^3 of nitrogen (at standard temperature and pressure) at a rate of 500 m^3/min for six minutes. The top set of perforations in this CBM well (125.5 to 126.4 mKb) was in the Weaver coal zone, the same as many of the local water wells including the Signer well. Given the similar depths of the CBM zones and the water wells, with a horizontal distance of 1.7 km, additional evaluation of possible effects of fracturing on the water-bearing aquifer is merited. Three possible effects are considered:

i. Change in water quantity (water levels) due to initial pressure increase during fracturing and from production of water from the aquifer.
ii. Change in water quality due to injected nitrogen reacting with the groundwater in the coal zone.
iii. Change in water quality (increased methane) from methane migration from deeper zones into the water-bearing aquifer.

i. A report by Hydrogeological Consultants Ltd (2005) calculated an estimated increase in water levels in a well, at a 1.2 km distance from the 00/05-14-027-22 W4M CBM well, caused by the injection of nitrogen. They calculated an increase in water level of 0.02 m would be expected to persist for 640 hours at a distance of 1.2 km. The details of the calculation are not presented in the consultants report, but it appears that they have used an equivalent porous media model to determine the changes. This may not adequately model fracture flow in coal aquifers. If the CBM well continued to produce water from the upper perforation during gas production, a drop in water levels would be expected over time. After the CBM well was completed, water was observed (during a video inspection) entering the 125.6 to 126.5 m interval (Hydrogeological Consultants Ltd 2005). The upper perforation of EnCana CBM well 00/05-14-027-22 W4M was unsuccessfully cement squeezed (abandoned) on July 1, 2004. The upper 4 perforations (between 125.5 and 142.4 m) were cement squeezed on July 12, 2004, successfully abandoning the zone. These zones would have been pressure tested to confirm successful abandonment. On October 10 2004 the whole well was abandoned with a cement plug from 17 to 425 m. The current public well ticket for this well states the status as “abandoned gas”. As the connection of the CBM well to the local water-bearing aquifer was eliminated by this cement squeeze, completed in within 4 months of fracturing and with only 4 m^3 of water was reported recovered from the well, no measurable effect on local water well quantity would be expected.

ii. The injected slug of nitrogen from the fracturing 00/05-14-027-22 W4M could potentially affect the water quality of water wells completed in the same aquifer. After fracturing of the 00/05-14-027-22 W4M CBM well, the nitrogen gas pressure was allowed to bleed off and then the well was “flowed” (pumped) for 75 days to produce back the nitrogen. An evaluation of amount of nitrogen removed from the coal zones during this flow was done by Hydrogeological Consultants Ltd (2005). This was based on an unreferenced graph titled “N_2 concentration decline post-stimulation- Strathmore well” that shows nitrogen concentration of produced gas as a function of flow time. The Hydrogeological Consultants Ltd (2005) evaluation concluded that “there is no reason to expect any significant nitrogen remained in the 125.5 to 126.5 metre coal

zone when the perforations were closed using a cement squeeze". The assumptions that this graph and calculations were based on are not stated so ARC does not have the information to validate the Hydrogeological Consultants Ltd conclusion.

iii. The connection between the upper and lower zones of the 00/05-14-027-22 W4M CBM well, through the shallower and deeper perforations, could potentially lead to the upward migration of methane from a lower zone to the water-bearing aquifer. Water entering the upper perforations of 00/05-14-027-22 W4M would tend to counteract the migration of methane into the water-bearing aquifer. A brief discussion of the physics involved in migration of a methane bubble is presented in section 4.4.5 below and in Appendix D). A study of the potential for methane migration from CBM zones into overlying aquifers is currently under investigation by AENV.

A residential water well is located about 1200 m south-west of the 00/05-14-027-22 W4M CBM well. Mr. Sean Kenny complained to EnCana that sediment started to be produced from an old (1950) water well on his property at NE-10-027-22 W4M and a 2000 well at 07-10-027-22 W4M. A new well for the Kenny property (completed September 29, 2004) at NE-10-027-22 W4M also produced sediment which did not significantly improve through well development. A thorough review of Mr. Kenny's wells is not within the scope of this ARC review. EnCana contracted Hydrogeological Consultants Ltd to investigate these complaints (Hydrogeological Consultants Ltd 2005 and 2006). Remedial work (placement of k-packers and liners) was performed on Mr. Kenny's wells and the amount of sediment did reduce (Hydrogeological Consultants Ltd 2005 and 2006). Unfortunately, no gas compositional or isotopic analyses were done on the energy well or Mr. Kenny's well during the time period of the perceived impact to help determine if there was any connection between the water well problems and CBM drilling.

Theoretical evaluations (Hydrogeological Consultants Ltd 2005) of the pressure pulse created by the injection and removal of the nitrogen during flowing of the well (calculated with same method as above) indicate an impact to Mr. Kenny's wells is unlikely. However, without direct measurement of water levels (pressures) and chemical/isotopic measurements in both the CBM well and the water wells during the event, it is inconclusive as to whether or not Mr. Kenny's wells were impacted by nitrogen fracturing of 00/05-14-027-22 W4M.

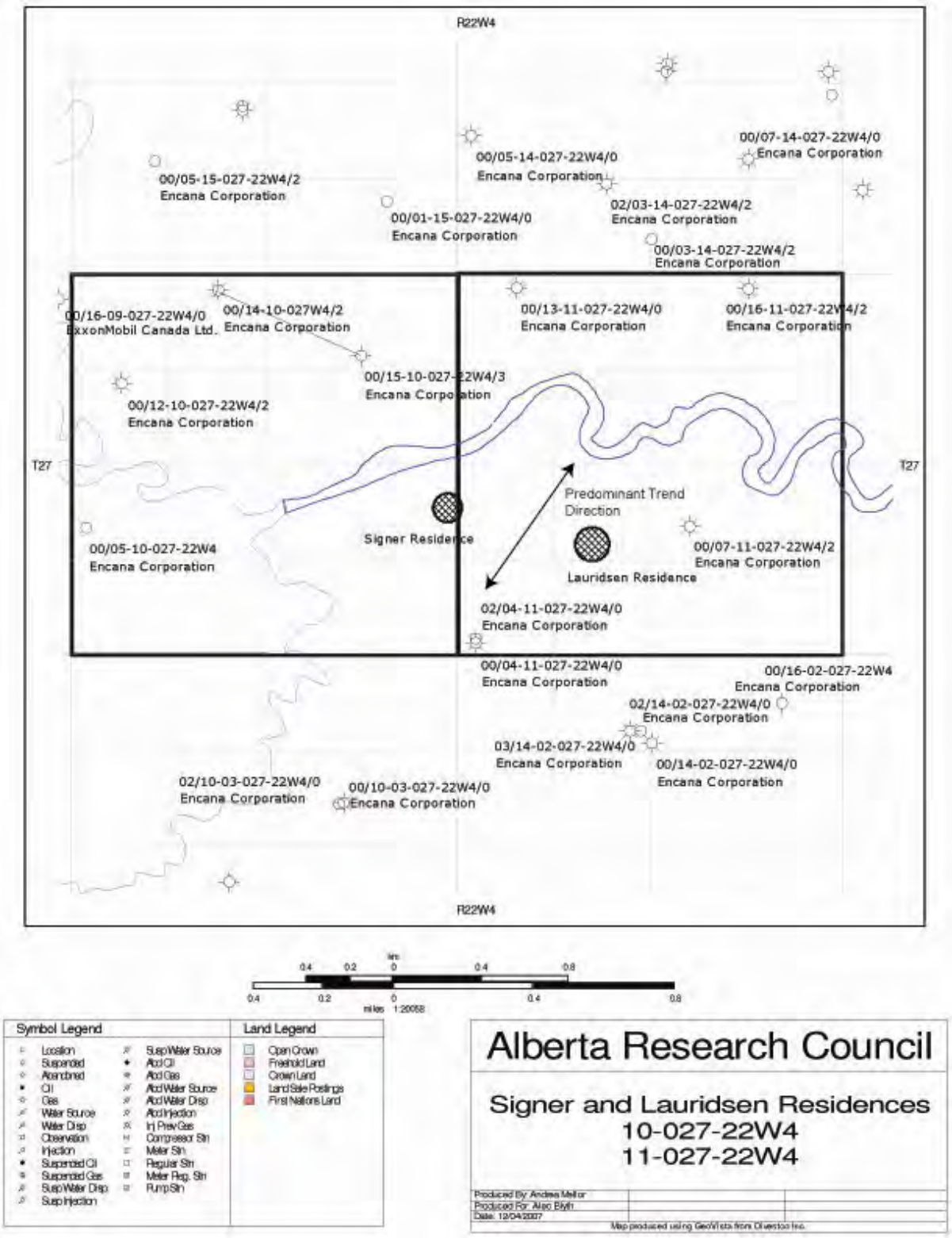


Figure 1 Energy wells in the vicinity of the Signer water well.

Table 1 AEUB review of wells near the Signer residence.

Well Location	Spud date/FDD/On Production	Surface Casing (mKb)	Total Depth (mKb)	Perforation Depths (mKb) and Dates	Fracture Depths (mKb) and Dates	Comments
00/14-10-027-22W4 Production history : Perfs 1479 – 1481 & 1476–1478, tested and abandoned. Perfs 1249-1252, on production 19 Jun 01 and perfs 559.5 -603 added July 02, and 461.5 – 464.5 & 451 – 455 added Aug 02. Packer installed at 459 Oct 02 to isolate water production from lower zones. CBM zones added in 07. Less than 1m3/d water production.	05 Mar 01 09 Mar 01 On prod. 19 Jun 01 & 25 Sep 07	182.0	1511.0	1479.0 – 1481.0 / 29 Mar 01 1476.0 – 1478.0 / 29 Mar 01 1249. 0 – 1252.0 / 11 Apr 01 559.5 – 603.0 / 6 Jul 02 461.5 – 464.5 / 28 Aug 02 451.0 – 455.0 / 28 Aug 02 All below on 16 Sep 07 401.4 – 401.9, 395.0 – 395.5 390.8 - 391.3, 349.3 – 349.8 326.0 – 327.0, 320.6 – 321.1 260.8 – 262.8, 259.3 - 259.8 249.9 – 250.4, 245.8 – 246.3 231.0 – 233.0, 229.7 – 230.2 220.7 – 221.2, 216.3 – 216.8 211.5 – 212.0, 210.0 – 211.0	1249.0 – 1252.0 / 1 May 01 559.5 – 603.0 / 2 Aug 02 Perfs between the depths of 210.0 – 401.9 were individually frac'd on 23 Sep 07	Bridge plug capped with cement at 1466.5 to 1474.5 (11 Apr 01) - abandoned lower zone .Also a bridge plug at 459.0 (11 Oct 02) to isolate lower zones. No lost circulation reported. Cement returns on surface and production casing. No wellbore issues evident. Upper perf at 632.90 MASL
00/15-10-027-22W4 (Directionally drilled well. Surface hole in 14-10 and bottom hole in 15-10.) Production history: 718-720 on production 19 Mar 05. CBM perfs on production 25 Sep 07. Water production less than 1m3/d	4 Jun 03 7 Jun 03 On prod. 19 Mar 05 & 25 Sep 07	135.0	1548.0	1498.0 – 1500.0 / 13 Aug 03 1414.0 – 1417.0 / 24 Oct 03 718.0 – 720.0 / 4 Dec 03 Following perfs - 16 Sep 07 740.2 – 741.2, 705.7 – 706.2 555.4 – 555.9, 404.4 – 404.9 399.4 – 400.4, 395.5 – 396.0 353.7 – 354.2, 328.9 – 329.9 232.0 – 323.5, 260.5 – 263.5 259.1 – 259.6, 257.3 – 257.8 239.2 – 239.7, 229.6 – 231.6 228.2 – 229.2, 225.4 – 225.9 219.0 – 219.5, 214.5 – 215.0 208.3 – 210.3	1498.0 – 1500.0/2 Oct 03 1414.0 – 1417.0/15 Nov 03 Perfs from 208.4 – 741.2 frac'd individually on 20 Sep 07	Lower zones abandoned w/ Bridge plugs capped w/ cement @ 1484 – 1492 on 23 Oct 03, and 1404 – 1412 on 5 Dec 03. No losses reported. Cement returns on surface and production casings. No wellbore issues evident. Upper perf at 634.4 MASL

Table 1 Continued.

Well Location	Spud date/FDD/On Production	Surface Casing (mKb)	Total Depth (mKb)	Perforation Depths (mKb) and Dates	Fracture Depths (mKb) and Dates	Comments
00/04-11-027-22W4	29 Oct 97 30 Oct 97 10 Jun 98	43.0	780.0	669.0 – 672.0 / 17 Nov 97 616.5 – 619 5	669.0 – 672.0 / 24 Nov 97	Lost circulation reported at 12 to 31 metres in overburden due to gravel. Lost circulation material (bentonite and lime) was pumped to regain circulation. Control regained at 43.0 m, and surface casing set. Cement returns on production and surface casings. Upper perf at 218.2 MASL
02/04-11-027-22W4	21 Jan 04 21 Jan 04 19 Nov 04	42.7	504.0	Following perfs on 22 Apr 04 190.5 – 191.5, 192.4 – 193.1 208.7 – 209.7, 212.1 – 214.1 248.1 – 251.1, 302.5 – 303.5 308.4 – 309.4, 332.3 – 333.3 334.9 – 335.9, 372.5 – 373.5	Perfs from 190.5 to 373.5 individually frac'd on 5 Jun 04	No lost circulation reported. Cement returns on surface and production casings. No apparent well bore issues. Upper perf at 644.3 MASL
00/07-11-027-22W4 Production history: Production from lower perfs on 03. Other perfs have not produced to date.	3 Dec 02 8 Dec 02 22 May 03	148.6	1286.0	1188.5 – 1191.5/16 Jan 03 636.0 – 639.0/20 Apr 04 604.0 – 607.0/ 8 Jun 04 Following perfs on 13 Apr 05 342.8 – 343.8, 337.0 – 338.0 299.4 – 300.4, 296.4 – 297.4 272.7 – 273.7, 211.9 – 214.9 188.0 – 189.0, 175.9 – 177.9	1188.5 – 1191.5/11 Feb 03 636.0 – 639.0/24 May 04 604.0 – 607.0/ 26 Jun 04 Perfs from 175.9 to 343.8 frac'd on 2 May 05	Lower zones abandoned with bridge plug capped with cement at 1172 – 1182 on 20 Apr 04, and a bridge plug at1137.3 to 1140.8 on 22 Jun 05. No lost circulation reported. Cement returns on surface and production casings. No apparent well bore issues. Upper perf at 622.6 MASL
00/05-14-027-22W4 Fluid level in well reached 80 mKB during shut-in prior to sampling upper perfs. There was a packer at 172.0 m in hole at the time. 4 m3 water reported recovered from well.	13 Oct 03 13 Oct 03 Not on production	85.0	467.0	Following perfs on 15 Feb 04 418.9 – 419.9, 415.5 – 416.5 374.3 – 375.3, 371.7 – 372.7 358.4 – 359.4, 354.5 – 355.5 347.8 – 348.8, 342.6 – 343.6 284.9 – 286.9, 283.5 – 284.5 259.3 – 260.3, 248.0 – 250.0 244.9 – 245.9, 238.6 – 239.6 234.6 - 235.6, 228.7 – 230.7 222.0 – 223.0, 220.1 0 221.1 186.1 - 187.1, 177.1 – 178.1 141.4 – 142.4, 133.0 – 134.0 131.7 – 132.7, 125.5 – 126.5	Perfs from 125.5 to 419.9 frac'd on 2 Mar 04	Cement squeezed top 4 perfs on 12 Jul 04: 141.4 – 142.4, 133.0 – 134.0 131.7 – 132.7, 125.5 – 126.5 Cement plug from 17.0 to 425.0 m on 10 Oct 04. Cement returns on surface and production casing. Cement top inside surface casing confirmed with log. No apparent wellbore issues. Upper perf at 743.0 MASL

4 SIGNER WATER WELL INFORMATION

4.1 Initiation of Well Complaint

The water well complaint by Ms. Signer was originally made to EnCana about a concern related to methane in her well. In September of 2004 EnCana's consultant, Hydrogeological Consultants Limited initiated an investigation and produced a report (Hydrogeological Consultants Limited 2004).

4.2 Well Design, Construction and Maintenance

The water well drilling report for the Signer Water Well, available through the AENV Groundwater Information Centre (GIC) (Well ID # 0299882), is included in Appendix B. The well was drilled and completed by Gerritsen Drilling on February 7, 2002. There is a clear lithology log that indicates that this well is completed in coal. The borehole was drilled and a 152 mm diameter PVC casing was inserted to 41.15 m and seated into the bedrock. After reaching competent bedrock and setting the casing, bentonite chips and cuttings were poured into the annulus between the borehole and the casing. This method of sealing is not preferred, as there is no way to ensure a proper seal the entire length of the annulus. As well, the water saturated, fine grained material encountered from 5.2 to 6.4 m in the borehole could have lead to bentonite bridging (sticking caused by water swelling the bentonite) at that point. It is not clear if the existing seal provides adequate protection against contamination of water from ground surface entering the well. Several water analyses (discussed below) did indicate coliform bacteria were present and this could indicate a poor seal in the upper part of the well. The hole was then drilled further to the total depth of the well which is approximately 56.08 m. A liner was installed from 37.8 to 56.1 m in the well to prevent loose material from the borehole wall entering the well. The liner was perforated by saw from 53.0 to 56.1 m. The casing extends to 0.68 m above ground surface. A cistern is used to provide storage because the well provides limited yield.

Notes in the AENV complaint file indicate that the well did not have regular shock chlorination. Total Coliform bacteria were too numerous to count (TNTC) in three separate analyses. E. Coli bacterial have been detected in this well. These bacterial results could indicate a poor well seal. No information on subsequent well maintenance is contained in the file, but the most recent sampling in June 2007 did not detect coliform bacteria. Bacterial analyses indicate that iron related bacteria (IRB) and sulphur reducing bacteria (SRB) are present in the well water.

4.3 Stratigraphy

A good quality lithology record is available for the Signer well through the AENV Groundwater Information Centre. A new AENV groundwater observation well network (GOWN) well (installed in March 2007) approximately 250 m to the north also provides detailed lithology information.

A geologic cross section through the Signer well was constructed using lithology information from the Kenny well, the Signer well, a GOWN well and geophysical logs from the EnCana CBM wells 05-14-027-22 W4M, 15-10-027-22 W4M and 07-11-027-22 W4M (Figure 2). The contour interval on this map is 2 m and the colour shading visually denotes elevation.

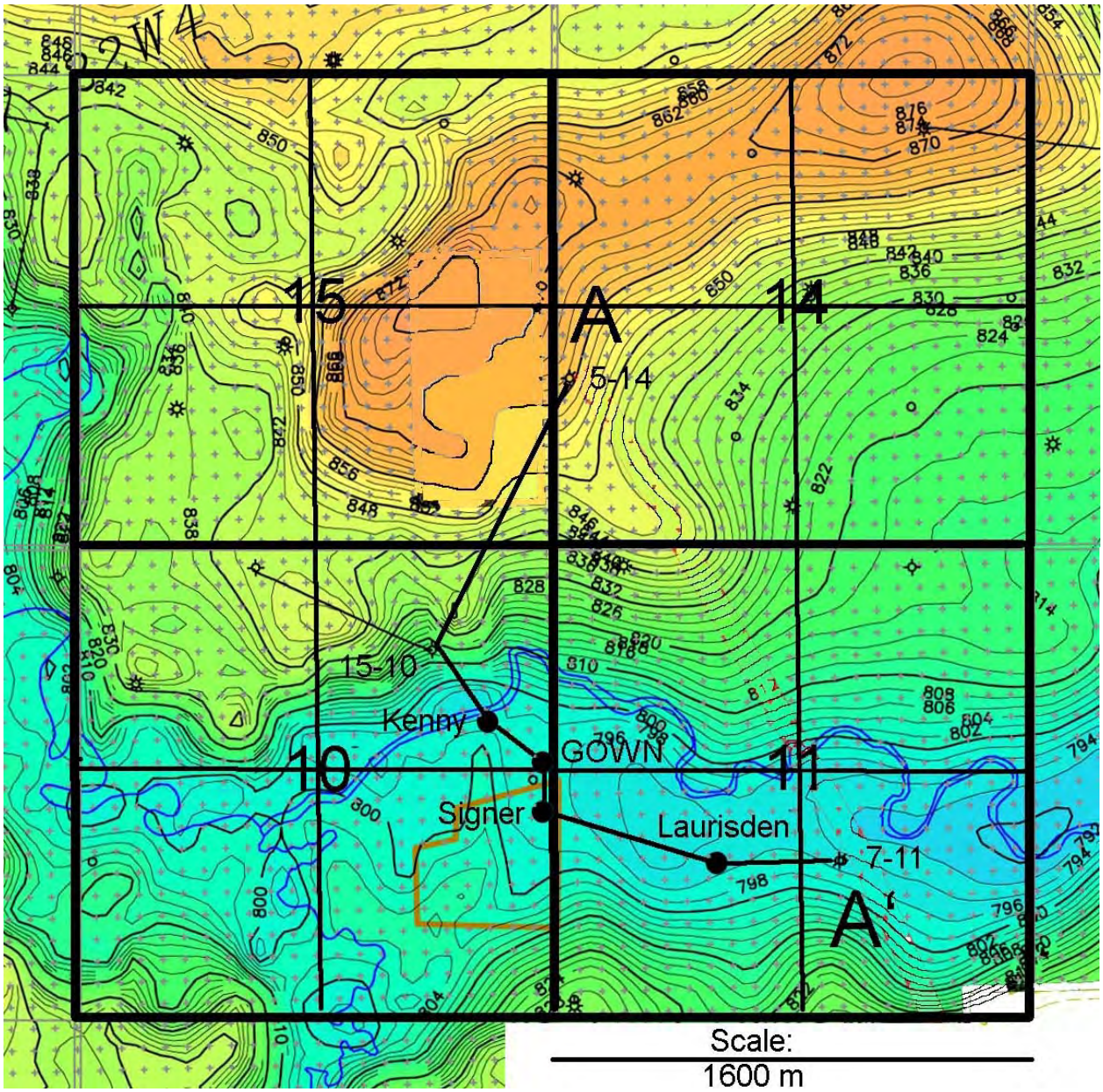


Figure 2 Map showing location of cross-section. DEM image supplied by EnCana.

The cross-section (Figure 3) illustrates that the Signer well is completed in coal zones of the Upper Horseshoe Canyon Formation (Weaver coal member) with the groundwater bearing zone at a depth of about 54 m (747 MASL). From nearby energy borehole logs, this zone is likely the Weaver coal zone. The EnCana 07-11-027-22W4M, 04-11-027-22W4M and 15-10-027-22W4M wells have production casing perforations starting at 622.6, 644.3 and 634.4 MASL respectively, which indicates a vertical separation of at least 103 m between the water-bearing zone of the

Signer well and the upper perforations of the energy wells. The 05-14-027-22W4M well, located about 1.7 km north of the Signer well, has perforations starting at 743 MASL. This is likely the same coal zone as the Signer well (as discussed above in section 3). A saturated sand and gravely sand layer was encountered in the residential water wells and in the GOWN well at a depth of about 2 to 6.5 m. This gravely sand layer is a potential pathway for water from the ground surface that infiltrates into the shallow subsurface to enter water wells if an adequate surface casing seal is not in place in the water wells.

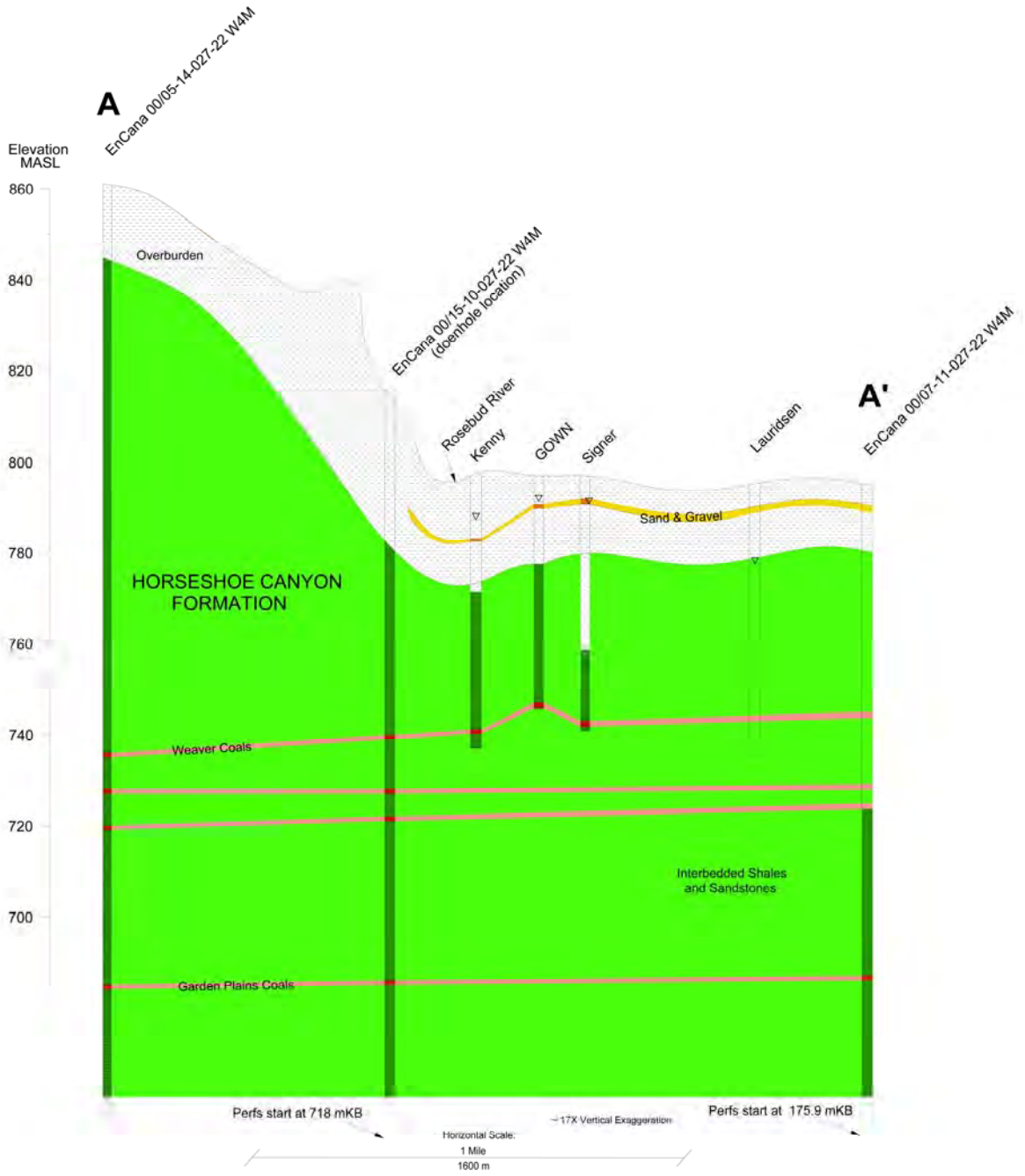


Figure 3 Geologic cross-section.

4.4 Hydrogeology

4.4.1 General Groundwater flow directions

Local and very shallow groundwater flow may be controlled by the unconfined sand and sandy gravel layer encountered at a depth of 2 to 5 m in several nearby water wells. The shallow flow is likely controlled by topography and flow directions are likely from the Signer well site to the Rosebud River to the north (Borneuf 1972). In the Signer well, the deeper confined groundwater flow within the upper Horseshoe Canyon bedrock is part of the regional groundwater flow system flow directed to the northeast (Bachu and Michael 2002).

4.4.2 Vertical Hydraulic Gradient

An estimation was made of the vertical hydraulic gradient between the coal zones of the Signer well and that of nearest EnCana CBM well with pressure data (02/14-02-027-22 W4M about 1.5 km to the south) using the following:

Depth of coal zone in Signer well = 747 MASL.
Depth of upper coal zone in EnCana CBM well 00/07-11-027-22W4M = 619 MASL.
The head of water in the Signer well = 794.8 MASL.
A shut-in pressure of 422.9 KPa was measured in the Garden Plains Coal member of EnCana CBM well 02/14-02-027-22W4M (equivalent to 43.2 m of water). Therefore the equivalent head of water in the CBM well = 662.2 MASL assuming density of 1000 kg/m^3 (fresh water).

The vertical gradient is estimated from = $\Delta h/\Delta l$ = (794.8-662.2)/(747-619) = 1.0. This suggests a large downward vertical gradient. If these coal zones become connected, groundwater would flow down into the CBM well. The rate of flow however, is going to be controlled by the hydraulic conductivity along the flow path. For example, if a fracture connects a CBM well to an overlying aquifer, the amount of groundwater produced could be significant, but will controlled by the fracture aperture.

4.4.3 Hydraulic Conductivity

Two pumping tests have been performed on the Signer Well. A 138 minute pumping test followed by a 100 minute recovery test was done February 2, 2002 by Gerritsen Drilling. A second 83 minute pumping test was performed by AENV on June 4, 2007 as part of a sampling event. An analysis of the February 2, 2002 was done by Hydrogeological Consultants Ltd (2004). No analysis of the June 4, 2007 data was found in the AENV file. The aquifer test data was analysed by ARC for this report using AQTESOLV, Version 3.50 Professional, Aquifer Test Design and Analysis Computer Software (1996-2003 HydroSOLVE Inc.). This software provides analytical solutions for evaluating parameters in confined, unconfined, leaky, or fractured aquifer systems, and allows evaluation of the aquifer test data by visual curve matching to select the most appropriate interpretation to represent aquifer conditions at the site. The raw data and graphical solutions are included in Appendix C.

The Theis (1935) confined aquifer solution was used to solve the drawdown and recovery portions of the pumping tests. An average apparent transmissivity of 1.25×10^{-4} m^2/min (0.18 m^2/day) was calculated. This is similar to the value of 0.12 m^2/day estimated in Hydrogeological Consultants Ltd report (2004). This value suggests that the aquifer has low to moderate transmissivity. No storativity value can be determined because it is not possible to calculate from water level measurements taken in a well that is being pumped. To calculate a storativity, water level measurements must be made in a non-pumping well in a well located a short distance from the pumping well. A storativity value of 0.005 can be estimated for this bedrock aquifer based on values reported in the literature (Freeze and Cherry 1979). The transmissivity and storativity can be used to estimate drawdown in water levels caused by pumping of the Signer well.

4.4.4 Water levels and methane saturation

Five static water levels from the Signer water well available over five years have been variable (Table 2). The maximum difference in water levels is 3.6 m which corresponds to a pressure difference of 0.35 Atm (5.1 PSI). A drop in pressure is expected to decrease the solubility of methane in the water and cause an increase in the amount of methane coming out of the water. This is similar to the case where pressure is decreased in a carbonated drink (by opening the top) and CO_2 bubbles out of solution. An estimation of the concentration of methane in water (in the Signer Well) at saturation can be done using the head (height) of water above the coal zone to calculate water pressure and then to use the Henry's Law equilibrium equation to relate water pressure to methane solubility:

Head of water above coal zone at the highest static water level = 48.2 m or 4.66 Atm

Head of water above coal zone at the lowest static water level = 44.6 m or 4.31 Atm

Henry's constant for methane = 1.4×10^{-3} Moles/Atm (at 25 °C or 298.15 °K)

A temperature correction needs to be done to the Henry's constant to account for the observed temperature of 285.65 °K (12.5 °C) in the Signer well:

Henry's constant for methane in water at 12.5 °C = 1.1×10^{-3} Moles/Atm

Therefore, based on this equation, the concentration of methane in water is calculated to be 5.13×10^{-3} Moles/kg of water at saturation for the highest static water level and 4.74×10^{-3} Moles/kg of water at saturation for the lowest static water level. This illustrates that with lower water levels or lower pressures, the solubility decreases and this could explain an increase in the amount of methane coming out of the water. However, it does not explain the source of the methane.

Table 2 Static water levels in the Signer well.

Date	Static Water Level (m TOC)
Feb 7, 2002	6.22
Nov 26, 2003	9.33
Sept 22, 2004	6.32
Sept 30, 2004	6.36
June 4, 2007	5.75

4.4.5 Potential for Methane Gas Migration

In order to estimate methane gas migration potential from an active CBM site to an overlying water supply aquifer, an assessment of the forces controlling the methane gas bubble migration is helpful. If an aquifer overlying a CBM zone was connected to the CBM zone through and induced fracture (from well stimulation) methane bubbles would tend to rise in the fracture due to buoyancy forces. Groundwater flow downward in the fracture would tend to counteract the buoyancy force and prevent the bubble from rising. Appendix D provides a discussion on how those forces are determined and presents simplified calculations (personal communication with Dr. J, Jones, PhD., University of Waterloo) that determine what kinds of flow conditions prevent methane gas bubble migration into an overlying water supply.

An example of the application of this approach for the case of an induced fracture connecting a CMB zone with an overlying aquifer (e.g. either in the geological medium or in a casing annulus) provides some estimates of groundwater flow in the fractures (under the observed gradients at the site) were compared to the terminal velocity (maximum velocity the bubble can reach given the density and viscosity of the fluids involved) of methane bubbles. For a 100 μm fracture, the flow velocity in the aperture would stop a methane bubble of 245 μm or less from rising into an overlying aquifer. In coal fracturing operations the intended fracture apertures are in the order of 1000 μm (1 mm) (personal communication with Paul Smolarchuk, Canadian Spirit Energy). An estimation of a downward groundwater flow velocity for the hydraulic gradient in the area in a 1 mm fracture indicates that a bubble of 2.5 mm or less would be stopped from rising. This kind of assessment suggests that if an induced connection existed between the CBM well and the Signer water well, methane bubbles would not tend to rise in these smaller fracture expected from fracturing because of the downward groundwater flow based on the hydraulic gradient estimated for the local area.

4.5 Water and Gas Chemistry

This section presents the results of ARC's compilation, review and assessment of water and gas chemistry data from the AENV and AEUB files (Signer well complaint file and energy well data) and additional data from D35 water well testing in the area (collected under AEUB Directive 35). Data from D35 testing was provided by AENV and from EnCana's consultant (WorleyParsons Komex). The chemistry from one hundred and forty five (149) water well tests

from a radius of approximately 10 km from the Signer well have become available from the new D35 AENV database and are compared here with the Signer water well and the CBM wells. Of these new well results, 42 have free gas analyses and/or isotope geochemistry. An analysis of this new chemistry data is organized into major ion chemistry, gas chemistry and isotope geochemistry.

4.5.1 Historical Major Ion and Bacteria Chemistry Prior to Complaint

Two historical water quality analyses are available for the Signer water well prior to the initiation of the complaint (Table 3). Copies of the analyses are included in Appendix E. The November 26, 2003 and August 13, 2004 samples (analyzed by WSH Labs) have routine potability analyses with ion balances within 2.5%. This is an acceptable lab QA/QC. It is not possible for ARC to comment on the field QA/QC as this type of information was not available. Both analyses show the Signer well water quality values are greater than the aesthetic objectives (set by the Summary Guidelines for Canadian Drinking Water Quality set by Health Canada 2007) for total dissolved solids (TDS) and sodium with average values of 1115 and 467 mg/L, respectively. As these sodium concentrations exceed the 200 mg/L guideline there may be a concern for people on sodium reduced diets. In addition, the aesthetic objectives for chloride is exceeded in the November 26, 2003 analysis with a value of 269 mg/L as compared to 250 mg/L for the standard. The maximum acceptable concentration of total coliforms was exceeded in the November 26, 2003 and August 13, 2004 analyses, with concentrations too numerous to count (TNTC). More recent sampling of this well (since June 2006) showed no coliform bacteria.

4.5.2 Major Ions, Metals and Bacterial Chemistry

In addition to the historic water analysis from the Signer well, several additional water analyses were performed after the complaint (Table 3). Routine potability analyses were from AENV sampling and Hydrogeological Consultants Ltd (2004). These analyses have ion balances of 10% which is an acceptable value. The results indicate that the Signer well consistently exceeds the aesthetic objectives for total dissolved solids (TDS) and sodium with results in a similar range to that measured prior to the complaint. As well, the aesthetic objectives for chloride and iron have at times been exceeded.

Bacterial analyses show the presence of total coliform bacteria in exceedence of the maximum acceptable concentration on five different sampling events. The coliform bacteria were too numerous to count on several occasions. Current available detection methods do not allow for routine analysis of all micro-organisms that may be dangerous to human health. The presence of the Coliform group of bacteria is used an indicator for the potential presence of disease-producing bacteria that normally live in the intestine of warm-blooded animals (fecal matter).

Bacterial identification was performed by HydroQual Laboratories Limited on samples from the Signer water well and from the cistern (June 14, 2006). Bacteria identified in all samples include: Enterobacter, Bacillus, Escherichia coli, Chromobacterium, Psuedomonas and

Alcaligenes. In addition, other micro-organisms, such as amoebae, flagellates, ciliates and possible water fleas were observed in all samples. Copies of the analyses are included in Appendix E. Observations of a heavy pink "slime" in the well and cistern was noted in the Hydrogeological Consultants Ltd report (2004) and in AENV field notes and photographs. Both the well and cistern have bacterial problems that are indicative of water from ground surface leaking into the well.

It is likely that the source of these organisms is close to the Signer well because these organisms generally do not possess the ability to persist in groundwater. The fate of bacteria from surface water (and other components) used in drilling fluids has been investigated by Cullimore and Johnston (2005). Changes in solar radiation, temperature, redox conditions, salinity, flow patterns and mixing with other drilling fluid components can have a control on the survival of bacteria. Bacteria from surface water in drilling fluids have short-term (less than seven days) impacts in the immediate vicinity (within two metres) of the well but would normally be expected to die off or be integrated into the natural groundwater communities (Cullimore and Johnston 2005).

The major ion chemistry of the D35 water wells, the Signer well and the GOWN wells is presented on Figure 4. The water well major ion chemistry for the Signer wells is Na-HCO_3-Cl type water. This water chemistry is typical of water wells in the area.There is a strong positive correlation of two specific water types in the area, namely sodium-bicarbonate (Na-HCO_3) and sodium-bicarbonate-chloride (Na-HCO_3-Cl) type waters, with the presence of methane in the water (shown in Figure 4). The Signer water well results show this correlation. This correlation relates to the reducing conditions, found where methane occurs in coalbed zones, that likely result in the biochemical reduction of dissolved sulphate, resulting in decreased sulphate. Bicarbonate, on the other hand, likely tends to be enriched in the coals as a result of carbonate dissolution by oxygenated recharge water and by sulphate reduction methane production (fermentation). Calcium and magnesium tend to be reduced by inorganic precipitation of calcite due to reduced solubility in the presence of elevated bicarbonate (Van Voast 2003).

The major ion chemistry is presented on Schoeller plots (Figure 5 and 6). Most of the wells with methane have decreased calcium, magnesium and sulphate. Again, these wells show the water wells with methane tends to have sodium-bicarbonate (Na-HCO3) or sodium-bicarbonate-chloride (Na-HCO3-Cl) type waters. The Signer water well falls into this group.

Table 3 Summary of Chemical Analyses for the Signer Water Well

Parameter	Units	Signer Well																						GCDWQ Recommended Limit	
Date	dd/mm/yyyy	26/11/2003	13/08/2004	22/09/2004	30/09/2004	16/05/2006	14/06/2006	14/06/2006	14/06/2006	14/06/2006	14/06/2006	14/06/2006	02/11/2006	02/11/2006	02/11/2006	02/11/2006	02/11/2006	02/11/2006	22/02/2007	04/06/2007	04/06/2007	04/06/2007	26/06/2007	AO	MAC
Time	hh/mm					12:30	11:00	11:30	11:45				13:05	13:55	16:26	16:27	16:28	16:31	12:30	16:00	16:00	16:55	11:18		
Location						Residence	Well	Cistern	Kitchen Tap	Well	Cistern 1	Cistern 2											Well		
Laboratory		WSHLabs	WSHLabs	Norwest	Norwest	ALS	ALS	ALS	ALS	HydroQual	HydroQual	HydroQual	ALS	ARC Veg	Maxxam	ARC Veg	Maxxam	ARC Veg	ALS	ALS	ARC Veg	UofC	ALS		
pH	units	8.15	8.12	8.38	8.42	8.4	8.5	8.5	8.5	---	---	---	8.4	---	---	---	---	---	7.8	8.5	---	**---**	**---**	6.5 - 8.5	---
EC	µS/cm	1941	1946	1890	1930	1910	1890	1900	1910	---	---	---	1870	---	---	---	---	---	1930	1870	---	**---**	**---**	---	---
TDS-calculated	mg/L	**1149**	**1107**	**1070**	**1090**	**1090**	**1120**	**1130**	**1090**	---	---	---	**1120**	---	---	---	---	---	**1140**	**1150**	---	**---**	**---**	500	---
Total Alk. as CaCO3	mg/L	666	662	694	693	683	667	691	694	---	---	---	683	---	---	---	---	---	679	602	---	**---**	**---**	---	---
Sodium	mg/L	**472**	**465**	**437**	**440**	**434**	**481**	**491**	**451**	---	---	---	**469**	---	---	---	---	---	**486**	**514**	---	**---**	**---**	200	---
Potassium	mg/L	<0.5	2.3	1.2	0.9	1.1	1.1	1.2	1.2	---	---	---	1	---	---	---	---	---	1.8	1.1	---	**---**	**---**	---	---
Calcium	mg/L	5.1	8.5	4.2	3.8	3.9	6	3.6	3.7	---	---	---	1.5	---	---	---	---	---	2.2	0.9	---	**---**	**---**	---	---
Magnesium	mg/L	<0.1	1	0.3	0.3	0.4	0.5	0.4	1.2	---	---	---	0.4	---	---	---	---	---	0.3	<0.1	---	**---**	**---**	---	---
Iron	mg/L	0.034	0.06	---	---	0.039	0.239	0.023	0.033	---	---	---	---	---	---	---	---	---	**0.333**	0.02	---	**---**	**---**	0.3	---
Iron (total)	mg/L	---	---	0.01	<0.01	0.1	<0.06	<0.06	0.12	---	---	---	---	---	---	---	---	---	1.06	0.061	---	**---**	**---**	---	---
Manganese	mg/L	<0.01	<0.01	---	---	0.003	0.013	0.003	0.007	---	---	---	---	---	---	---	---	---	0.011	0.003	---	**---**	**---**	0.05	---
Manganese (total)	mg/L	---	---	<0.005	<0.05	<0.02	<0.02	<0.02	<0.02	---	---	---	---	---	---	---	---	---	0.012	0.004	---	**---**	**---**	---	---
Chloride	mg/L	**269**	232	212	224	239	232	220	221	---	---	---	238	---	---	---	---	---	237	**264**	---	**---**	**---**	250	---
Fluoride	mg/L	1.5	1.43	1.26	1.3	**---**	---	---	---	---	---	---	---	---	---	---	---	---	**---**	**---**	---	**---**	**---**	---	1.5
Sulphate	mg/L	<0.6	<0.6	0.45	0.6	<0.5	<0.5	<0.5	<0.5	---	---	---	0.9	---	---	---	---	---	1.2	4.5	---	**---**	**---**	500	---
Carbonate	mg/L	0	0	7	12	12	17	20	20	---	---	---	12	---	---	---	---	---	<5	15	---	**---**	**---**	---	---
Bicarbonate	mg/L	812	807	831	820	809	780	801	805	---	---	---	809	---	---	---	---	---	828	704	---	**---**	**---**	---	---
NO3 as N	mg/L	1.5	<0.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05	---	---	---	<0.05	---	---	---	---	---	0.07	<0.5	---	**---**	**---**	---	10
NO2 as N	mg/L	<0.3	<0.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---	---	---	<0.05	---	---	---	---	---	<0.05	<0.5	---	**---**	**---**	---	1
NO2+NO3 as N	mg/L	1.5	<0.2	<0.2	<0.2	<0.05	<0.05	<0.05	<0.05	---	---	---	<0.07	---	---	---	---	---	<0.07	<0.7	---	**---**	**---**	---	10
Ion Balance %	%	99	105	97.0	96.0	93.8	107	108	99.1	---	---	---	101.0	---	---	---	---	---	105	115	---	**---**	**---**	---	---
Bacteria																									
Total Coliforms	cfu/100mL	**TNTC**	**TNTC**	<1	<1	<1	**CGWC**	<1	<1	**Present**	**Present**	**Present**	**600**	---	---	---	---	---	**10**	**---**	---	**---**	**---**	---	0
Total Coliforms	mpn/100mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<1	---	**---**	**---**	---	0
Escherichia Coli	cfu/100mL	0	0	<1	<1	<1	**2**	<1	<1	**Present**	**Present**	**Present**	<1	---	---	---	---	---	<1	---	---	**---**	**---**	---	0
Escherichia Coli	mpn/100mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<1	---	**---**	**---**	---	0
S Reducing Bacteria	cfu/mL	---	---	---	---	---	---	---	---	---	---	---	200	---	---	---	---	---	---	<200	---	**---**	**---**	---	---
S Reducing Bacteria	MPN/mL	---	---	---	---	<0.3	<0.3	<0.3	<0.3	---	---	---	---	---	---	---	---	---	---	---	---	**---**	**---**	---	---
S Reducing Bacteria	Aggressivity	---	---	high	high	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Iron Related Bacteria	cfu/mL	---	---	---	---	<10	<10	250	90	---	---	---	9000	---	---	---	---	---	---	9000	---	**---**	**---**	---	---
Iron Related Bacteria	Aggressivity	---	---	high	high	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Hydrocarbons																									
Benzene	mg/L	---	---	---	---	<0.0005	---	---	---	---	---	---	---	---	---	---	---	---	<0.0005	---	<0.0001	**---**	**---**	---	0.005
Toluene	mg/L	---	---	---	---	<0.0005	---	---	---	---	---	---	---	---	---	---	---	---	<0.0005	---	<0.0001	**---**	**---**	0.024	---
EthylBenzene	mg/L	---	---	---	---	<0.0005	---	---	---	---	---	---	---	---	---	---	---	---	<0.0005	---	<0.0001	**---**	**---**	0.0024	---
Xylenes	mg/L	---	---	---	---	<0.0005	---	---	---	---	---	---	---	---	---	---	---	---	<0.0015	---	<0.0001	**---**	**---**	0.3	---
F1(C6-C10) - BTEX	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.01	**---**	**---**	---	---
F2 (C10-C16)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.05	**---**	**---**	---	---
F3(C16-C34)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.02	**---**	**---**		
F4(C34-C50)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.02	**---**	**---**		
Dissolved Gas Analysis																									
Nitrogen	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	10.8	---	---	---	---	---	---	11.3	**---**	**---**	---	---
Carbon Dioxide	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	7.2	---	---	---	---	---	---	402	**---**	**---**	---	---
Oxygen	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.34	**---**	**---**	---	---
Methane	µg/L	---	---	---	---	27000	---	---	---	---	---	---	---	34100	---	---	---	---	---	110000	26200	**---**	110000	---	---
Ethane	µg/L	---	---	---	---	<5	---	---	---	---	---	---	---	3.1	---	---	---	---	---	---	3.10	**---**	**---**	---	---
Propane	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.01	**---**	**---**	---	---
n-Butane	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.01	**---**	**---**	---	---
i-Butane	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	<0.01	**---**	**---**	---	---
δ13C Methane	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-66.3	**---**		
Free Gas Analysis																									
Nitrogen	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	151500	264000	126300	98000	---	---	210000	**---**	**---**	---	---
Carbon Dioxide	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	2100	2390	2200	1800	---	---	1940	**---**	**---**	---	---
Oxygen	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	36200		28400	---	---	---	39600	**---**	**---**	---	---
Methane	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	810200	739000	843100	932000	---	---	847000	**---**	**---**	---	---
Ethane	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	<100	21.2	<100	13.4	---	---	28.80	**---**	**---**	---	---
Propane	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	<100	---	<100	0.0308	---	---	<0.05	**---**	**---**	---	---
n-Butane	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	<100	---	<100	0.0083	---	---	<0.05	**---**	**---**	---	---
i-Butane	ppm	---	---	---	---	---	---	---	---	---	---	---	---	---	<100	---	<100	0.0154	---	---	<0.05	**---**	**---**	---	---
δ13C CO2	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	-15.4	---	-16.66	---	---	---	---	0.7	**---**	---	---
δ13C Methane	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	-65.66	---	-68.09	---	---	---	---	-66.9	**---**	---	---
δ13C Ethane	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	-40.62	---	-40.11	---	---	---	---	nd	**---**	---	---
δ13C Propane	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	nd	**---**	---	---
δ13C n-Butane	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	nd	**---**	---	---
δ13C i-Butane	‰ PDB	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	nd	**---**	---	---

GCDWQ - Health Canada Guidelines for Canadian Drinking Water Quality (2007)
AO - Aesthetic objective
MAC - Maximum acceptable concentration
nd - not detected by gas chromatography so not run for isotopes
--- not analyzed
TNTC - Too numerous to count
CGWC - Confluent Growth with Coliforms
Bold font denotes exceedence of GCDWQ limit

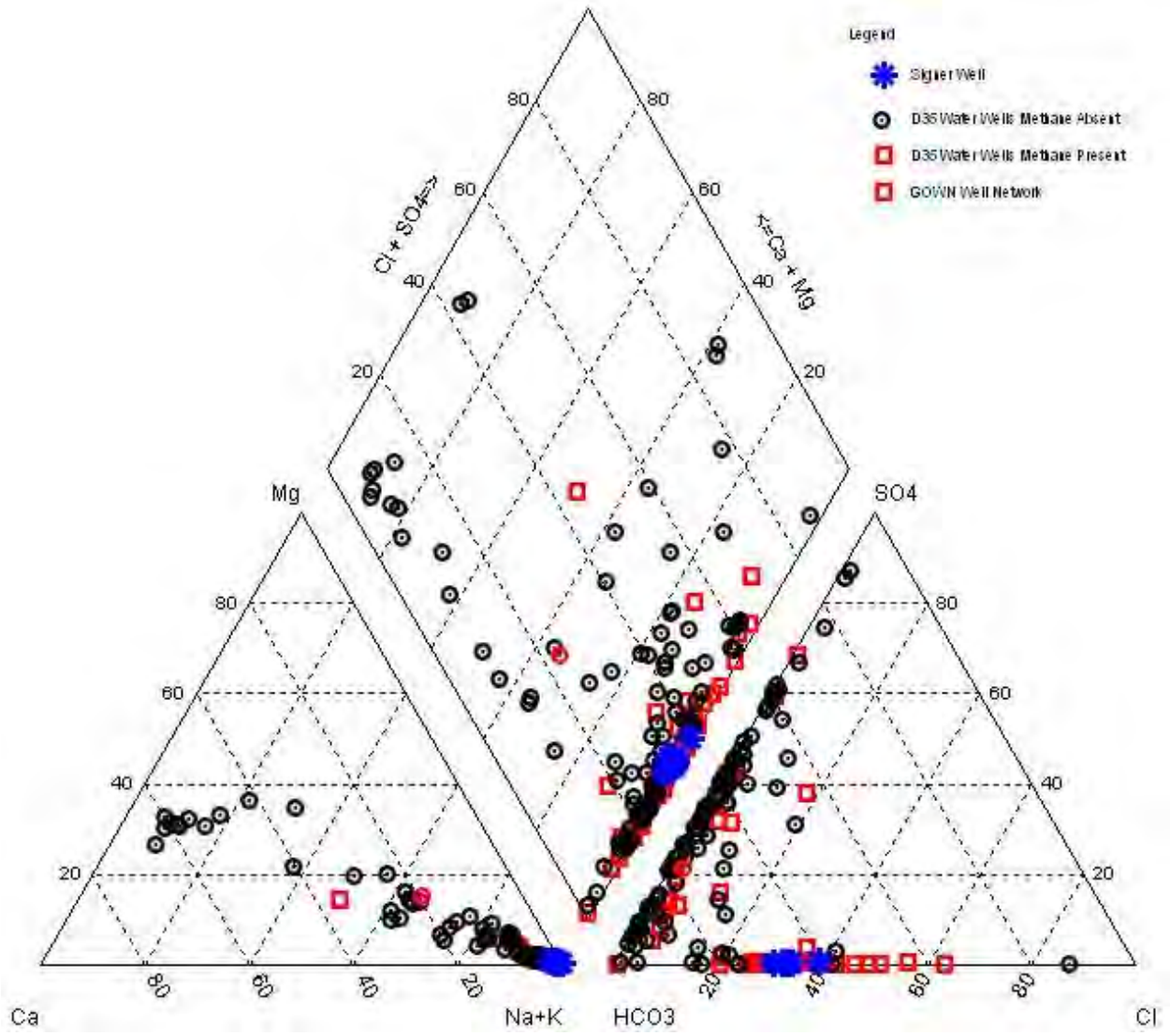


Figure 4. Piper plot of water chemistry from the Signer well, Surrounding D35 water wells and the GOWN wells.

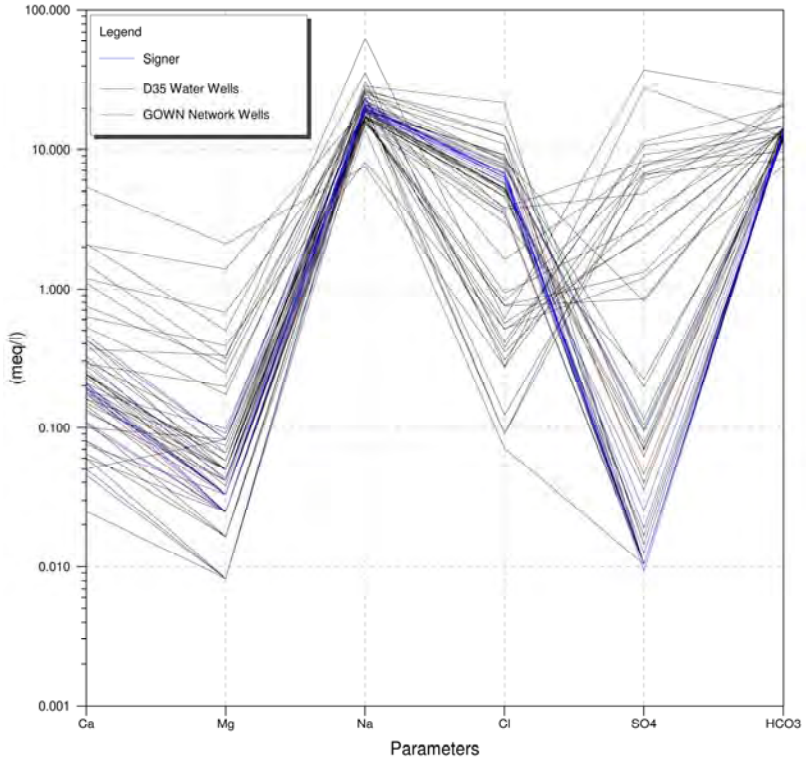


Figure 5 Schoeller plot of water wells with methane present.

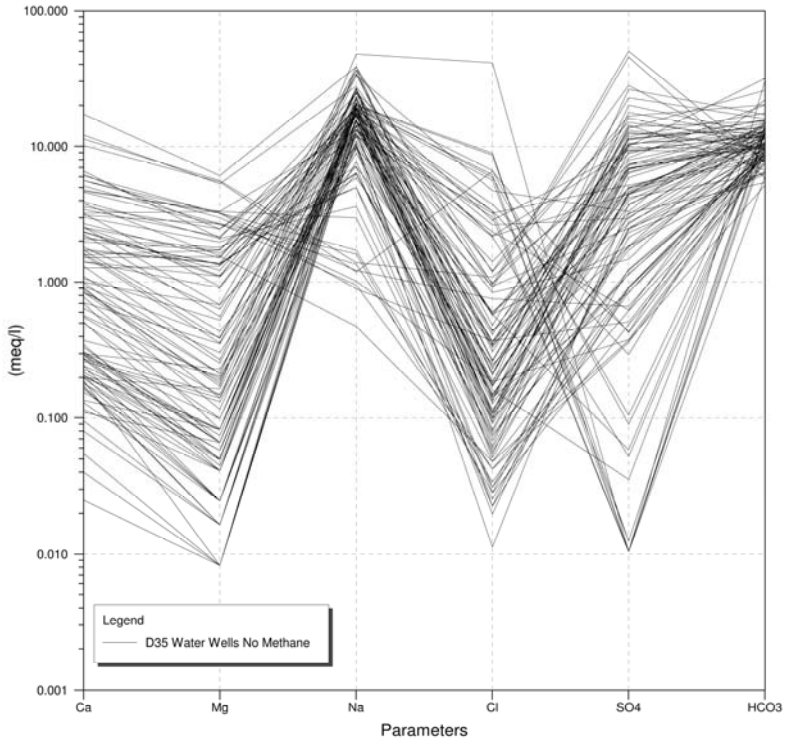


Figure 6 Schoeller plot of water wells with no methane.

4.5.3 Dissolved Organic Chemistry

An analysis for EPA volatile priority pollutants and extractable priority are available for the Signer well (Table 3 and Appendix E). All volatile and extractable organic compounds were below the analytical detection limit with the exception of one compound not expected to be related to CBM activities. This compound, 2-Methyl-2-Propanol (1 µg/l), is an alcohol used as a solvent (Grant Prill, ARC, personal communication) and may have come from cleaning of the AENV sampling equipment prior to sampling the well. Three BTEX and two F1-F4 analyses were done on the Signer well (Table 3). All BTEX and F1234 analyses were below detection limit. No Canadian Drinking Water Guideline limits have been exceeded for EPA priority pollutants or CCME hydrocarbons.

Four dissolved methane analyses were available for the Signer well with concentrations ranging from 27,000 to 110,000 µg/l. These concentrations are at or above the saturation and methane would be expected to exsolve from the water. One high precision dissolved gas analysis (method detection limit = 0.01µg/L) was performed on the Signer well (Table 3) with methane (34,100 µg/l) and a small amount of ethane (3.1 µg/l) detected. The methane concentration was above saturation in water and would be expected to exsolve. There is a risk that methane can form an explosive mixture with air.

4.5.4 Atmospheric Elements and Hydrocarbon Gas Chemistry

Several free gas analysis are available for the Signer well (Table 3). The samples appear to be free from atmospheric contamination (based on low oxygen and nitrogen values). The gas samples contain 739,000 to 932,000 ppm methane and 13.4 to 28.8 ppm ethane. There is a risk that methane can form an explosive mixture with air. C3 and higher gases were below the detection limit (e.g. 0.05 ppm in the June 4, 2007 analysis). In addition to the Signer well, 36 nearby water wells from the D35 database and 3 GOWN wells have gas chemistry. Methane and ethane concentration are similar to those measured in the Signer well. A more rigorous, statistical approach to differentiate gas characteristics is presented at the end of this section.

An analysis of hydrocarbon gas on November 2, 2006 (Appendix E) detected several hydrocarbon components. The analysis is indicative of contamination from conventional hydrocarbons (Grant Prill, ARC, personal communication). The source of hydrocarbons in this free gas sample is not clear. No corresponding sample was taken for the dissolved hydrocarbon components at the time. However, both dissolved gas and free gas samples from June 4, 2007 detected no higher order hydrocarbons (nothing other than methane and ethane).

To address the concern that the nitrogen fracturing could have affected the Signer water well, the nitrogen concentration of the free gas in the Signer well was compared to concentrations in D35 wells, the GOWN wells, several CBM wells and conventional gas wells. The Signer well analyses range from 9.8 to 26.4 % nitrogen. The cause of the variability is unknown but it could be due to the location that the sample was taken from (pressure or temperature differences

between the well, house tap or cistern) , and possibly to sampling procedure variability between different sampling events or different field personnel. A histogram of the nitrogen gas content from D35 water wells (Figure 7) shows two groups. One group falls in a range of 5 to 30% nitrogen while the other group is greater than 50% nitrogen. The group with greater than 50% nitrogen tends also to have lower methane concentrations and may be indicative of atmospheric contamination in the sample. Nitrogen levels could also be higher due to another factor such as breathing wells (wells that introduce air during atmospheric pressure highs and expel air with depleted oxygen content during atmospheric pressure lows) which have been noted in Alberta (Hydrogeological Consultants Ltd 1999), or to aquifer connection to the atmosphere at some distant point from the well (such as an aquifer outcrop on a valley wall). Natural nitrogen concentrations in coal in the energy wells are less than 15%. The Signer well nitrogen analyses fall within the normal range observed for the D35 wells with no air contamination. And do not appear to contain additional nitrogen from fracturing activities

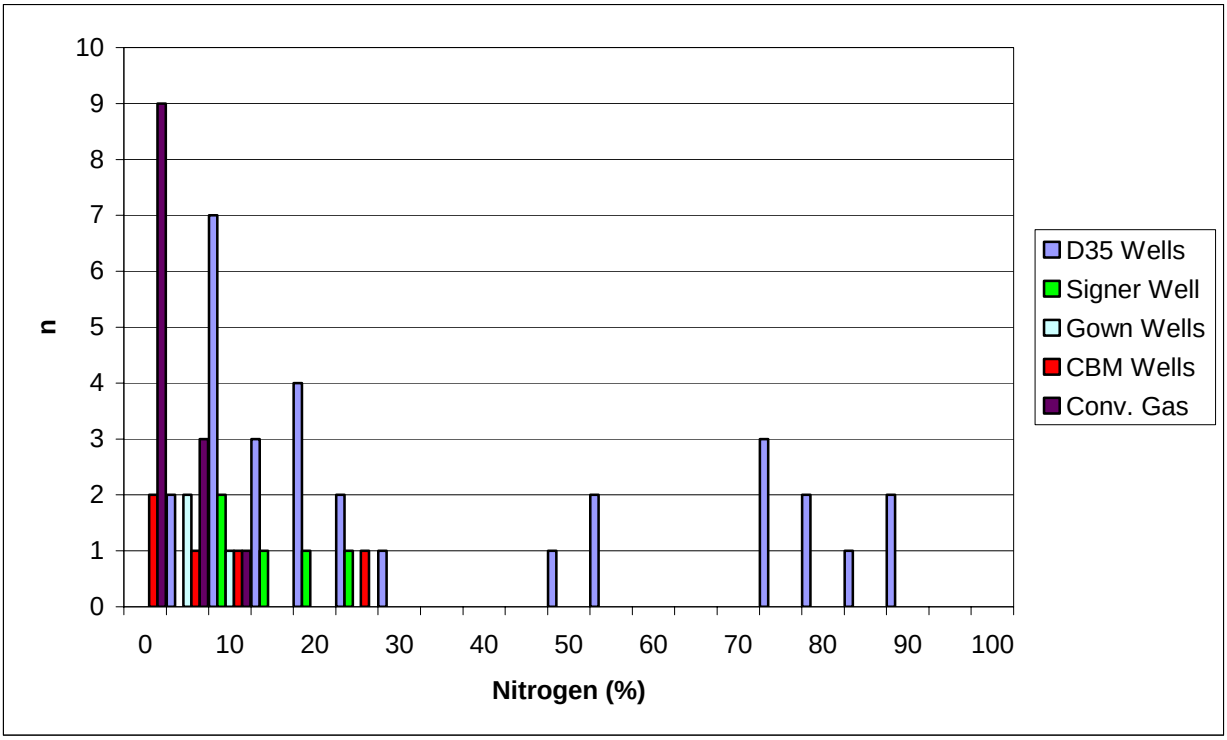


Figure 7 Histogram of nitrogen concentrations in water wells and energy wells.

4.5.5 Stable Carbon Isotope Chemistry on Hydrocarbon Gas

Stable carbon isotopes sometimes can be used to help in the identification of the origin of gas in water wells. Two carbon isotope analyses on hydrocarbon gas were available for the Signer well (Table 3). In addition to the Signer well, 27 nearby water wells from the D35 database and 3 GOWN wells have carbon isotope analyses on the hydrocarbon gases and on the carbon dioxide gas. Carbon isotope analyses were also available for the EnCana CBM wells located in 08-12-027-22 W4M, 03-14-027-22 W4M, 07-13-027-22 W4M, 06-24-027-22 W4M and 14-12-027-22 W4M. Carbon isotope analyses were also available for the EnCana conventional gas wells located in 08-12-027-22 W4M and 14-12-027-22 W4M.

Isotopic results from the Signer well (June 4, 2007) and the GOWN wells in Rosebud and Redland were performed by the Applied Geochemistry group at the University of Calgary using a gas chromatograph coupled to a Finnigan MAT delta plus XL mass spectrometer (3 kV). This analytical setup requires at least 500 ppm methane, 300 ppm ethane and 200 ppm propane in the injected gas to stay in the linear range of the mass spectrometer (Dr. Bernhard Mayer, personal communication). The reported $\delta^{13}C$ values have a precision of +-0.5 per mil for both free and dissolved gases (He helium headspace equilibration technique). The analytical technique used for gas isotope results of the D35 samples and an earlier Signer well sample (two samples from November 2, 2006) is not known.

Some of the energy wells results have questionable quality data based on a qualitative QA/QC assessment presented in Table 4. The GC analysis for 02/08-12-027-22W4M and 00/08-12-027-22W4M appears to be representative of CBM and conventional gas respectively, but the isotope values of the methane are not. It appears that the samples may have got mixed up and the CBM gas sample was labelled as the conventional gas sample and vice versa. The sample from 00/03-14-027-22W4M appears contaminated by air, based on the composition being predominantly nitrogen and oxygen, with hydrocarbons below the detection limit. These analyses were not used in the ARC evaluation.

The new deep GOWN (Groundwater Observation Well Network) well in Rosebud, completed in the Drumheller coals, is from a shallow (140 m) CBM zone in the area. This well has no water but does have flowing gas. Several of the CBM wells are representative of CBM gas compositions. However, deeper CBM well gas carbon isotopes are not well represented in the area due to the problems noted above. Additional data from CBM wells from Township 45, Ranges 20 and 21 was used to compare the Signer well carbon isotopes to typical deeper CBM well carbon isotopes.

Table 4 Energy (and GOWN) well QA/QC data quality.

Well Name	Type	GC	Isotopes	Data Quality
GOWN Rosebud #1 SW-18-027-21W4M	CBM	Yes	Yes	Acceptable
02/04-44-027-22W4M	CBM	Yes	No	Acceptable
02/08-12-027-22W4M	CBM	Yes	Yes	Isotope results may be from 00/08-12 (lab error?)
00/03-14-027-22W4M	CBM	Yes	Yes	Air contaminated sample
00/05-14-027-22W4M	CBM	Yes	No	Acceptable
00/06-24-027-22W4M	CBM	Yes	No	Acceptable
00/14-10-027-22W4M	Conv.	Yes	No	Acceptable
00/15-10-027-22W4M	Conv.	Yes	No	Acceptable
02/04-11-027-22W4M	Conv.	Yes	No	Acceptable
00/07-11-027-22W4M	Conv.	Yes	No	Acceptable
00/08-12-027-22W4M	Conv.	Yes	Yes	Isotope results may be from 00/08-12 (lab error?)
00/14-12-027-22W4M	Conv.	Yes	Yes	Acceptable
00/07-13-027-22W4M	Conv.	Yes	No	Acceptable

A histogram of the carbon isotope values of methane from the Signer water well, the surrounding D35 water wells, CBM wells and conventional gas is presented in Figure 8. The methane values for the Signer well generally fall within the peak of the distribution for methane values. A statistical analysis of the mean isotopic compositions is presented at the end of this section. From a visual observation of the plot, it is observed that the CBM wells have a less depleted (less negative) methane isotope signature, while the one conventional gas signature is even more enriched. The D35 wells and Signer well have methane isotope signatures that fall within the range of -60 to -80, typical of biogenic methane (Schoell 1980; Whiticar et al. 1986; Rice 1993).

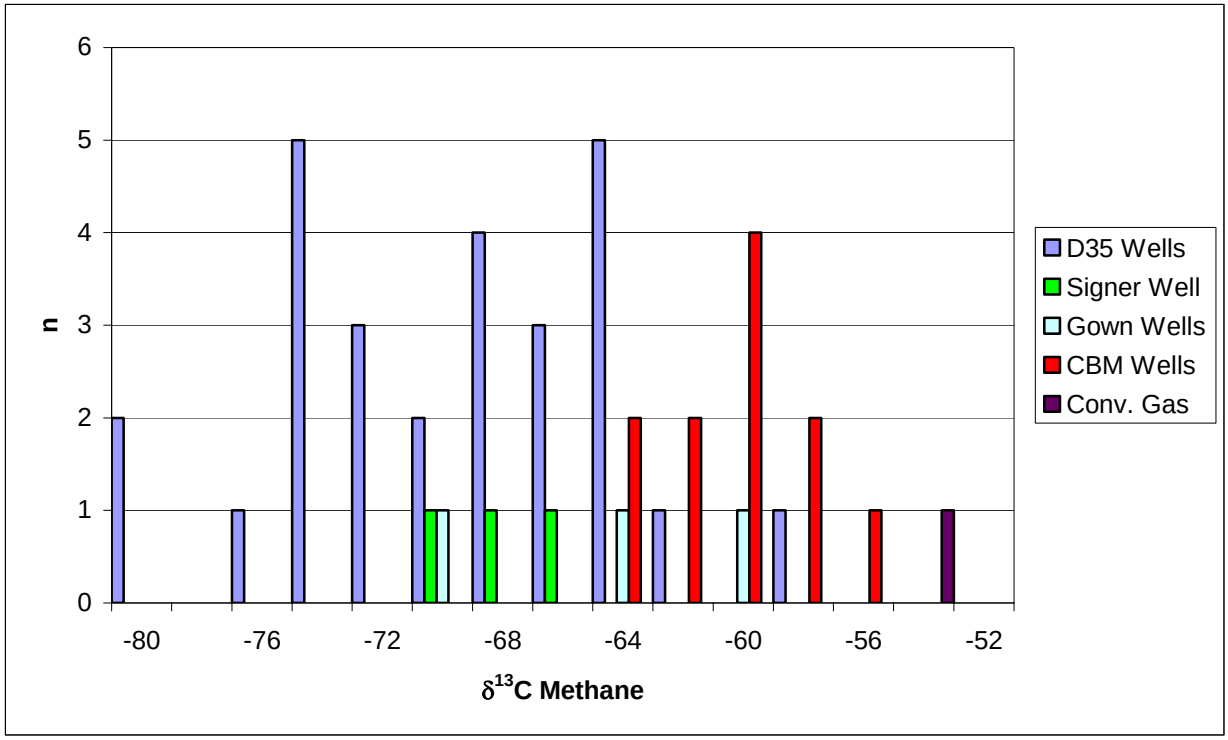


Figure 8 Histogram of the carbon isotope values of methane in all water wells and Energy wells.

A histogram of the carbon isotope values of ethane from the D35 water wells, the GOWN well, CBM wells and conventional gas is presented in Figure 9. The Signer well, CBM wells and surrounding D35 wells all have ethane isotope signatures that fall within the same general range. The conventional gas well (Viking Formation) has a much less depleted ethane isotope signature.

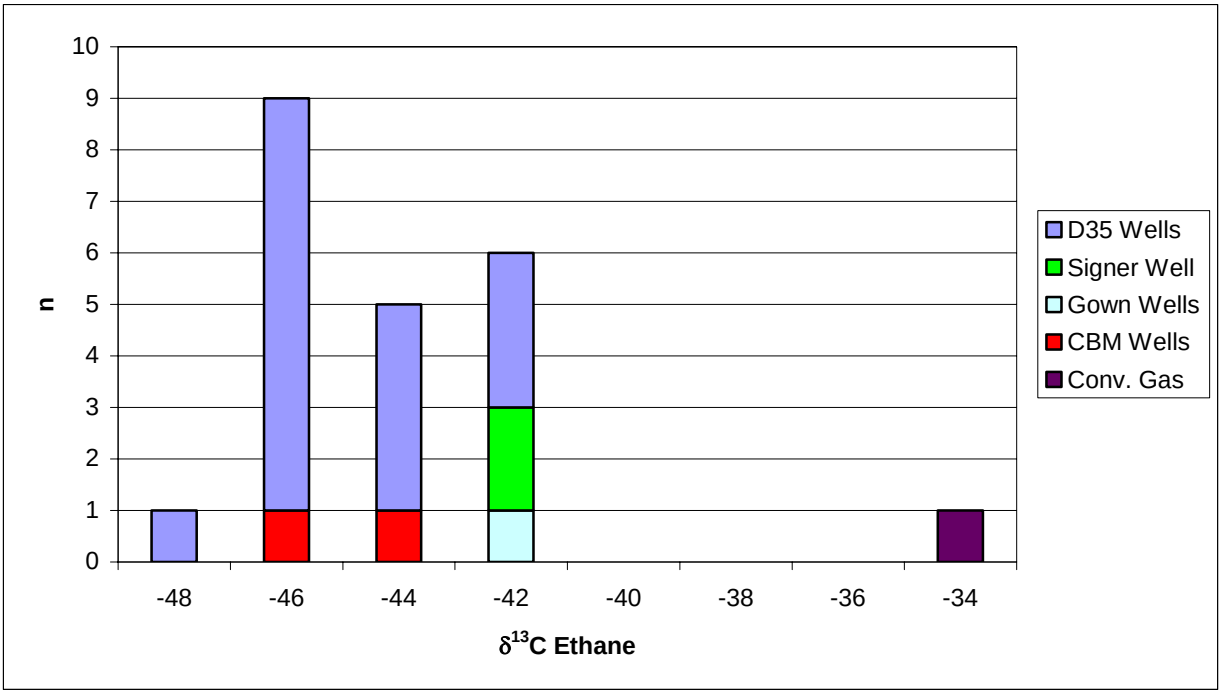


Figure 9 Histogram of the carbon isotope values of ethane in all water wells and energy wells

A plot of the methane concentration versus the methane carbon isotope signature ($\delta^{13}C_{Methane}$) is presented on Figure 10. Below the line at -60 ‰ typically represents a biogenic (bacterial) origin for methane (Schoell 1980 and 1983; Whiticar et al 1986; Rice 1993). The CBM and conventional gas wells have a $\delta^{13}C_{Methane}$ values that are less enriched than the typical range of -60 to -80 ‰, typical of biogenic methane. This value represents a mixed thermogenic and biogenic origin. The water well data, including the Signer well, all have $\delta^{13}C_{Methane}$ values that are clearly biogenic.

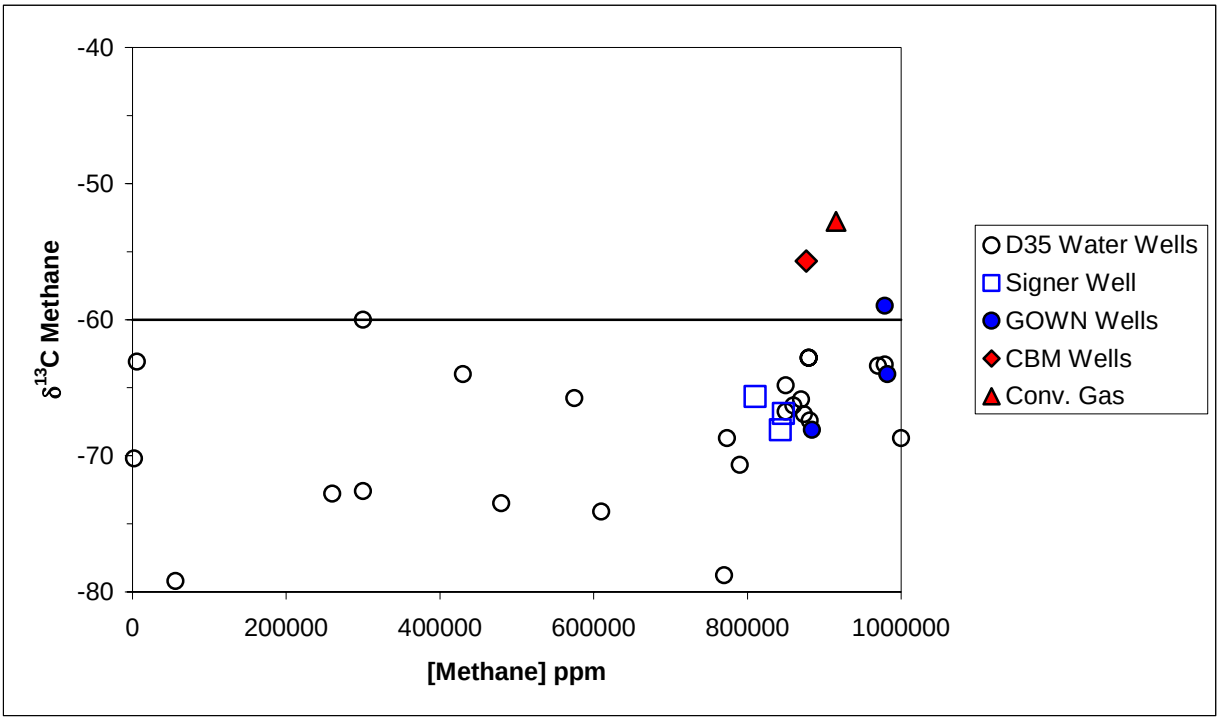


Figure 10 Methane concentration versus $\delta^{13}C$ of methane.

A plot of the ethane concentration versus the ethane carbon isotope signature ($\delta^{13}C_{Ethane}$) is presented on Figure 11. Most of the water wells have ethane concentrations below the lab detection limit (which was high as 100 ppm for some analyses). The Signer well has 21.1 ppm ethane (average of 3 analyses), which is below the method detection limit to run carbon isotopic analysis of ethane at the University of Calgary and the University of Waterloo (personal communication with Dr. Bernhard Mayer, University of Calgary and Robert Drimmie, University of Waterloo). The method, including the detection limit, used to determine ethane isotopes in the two Maxxam (and University of Alberta) analyses for samples taken on November 2, 2006 is not stated. Ethane isotope results on such low concentration may not be accurate. Of the D35 wells with detectable ethane, concentrations are several times less than that observed in the CBM wells or the deep GOWN well in Rosebud suggesting a different source for the ethane or only a small proportion of mixing (discussed later). The $\delta^{13}C_{Ethane}$ values of the water wells, including the Signer well, are within the range of $\delta^{13}C_{Ethane}$ values observed in the CBM well and the GOWN well. The ethane concentration and isotopic signature of ethane from the conventional gas well is markedly different from the water wells and the CBM wells. A more rigorous statistical approach to mean isotope values with more detailed interpretations are presented at the end of this section.

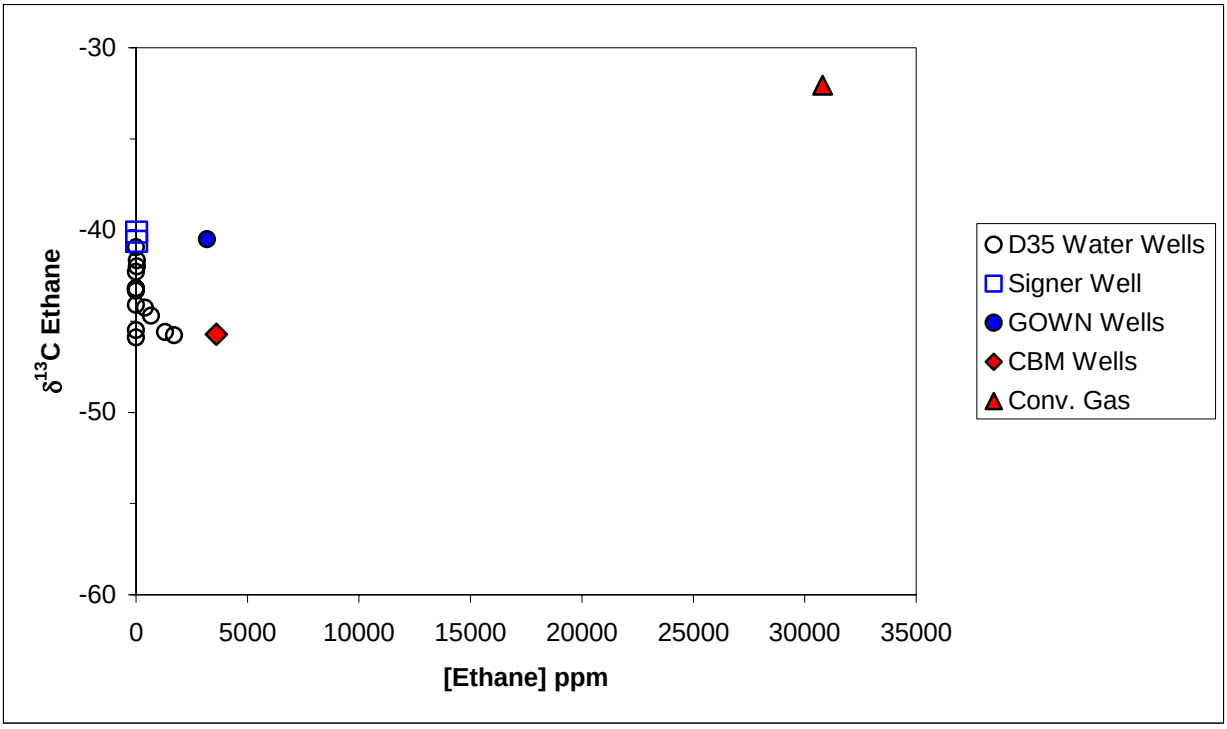


Figure 11 Ethane concentration versus $\delta^{13}C$ of ethane.

A plot of the methane carbon isotope signature ($\delta^{13}C_{Methane}$) versus the ethane carbon isotope signature ($\delta^{13}C_{Ethane}$) is presented on Figure 12. The $\delta^{13}C_{Methane}$ values of the CBM wells, the deep GOWN well and the conventional gas well are less depleted than the water wells. The $\delta^{13}C_{Ethane}$ values of the CBM wells and the GOWN well are similar to the D35 water wells. The $\delta^{13}C_{Ethane}$ values of the Signer well more enriched than the D35 wells or the CBM wells and is very similar to the new deep GOWN well in Rosebud.

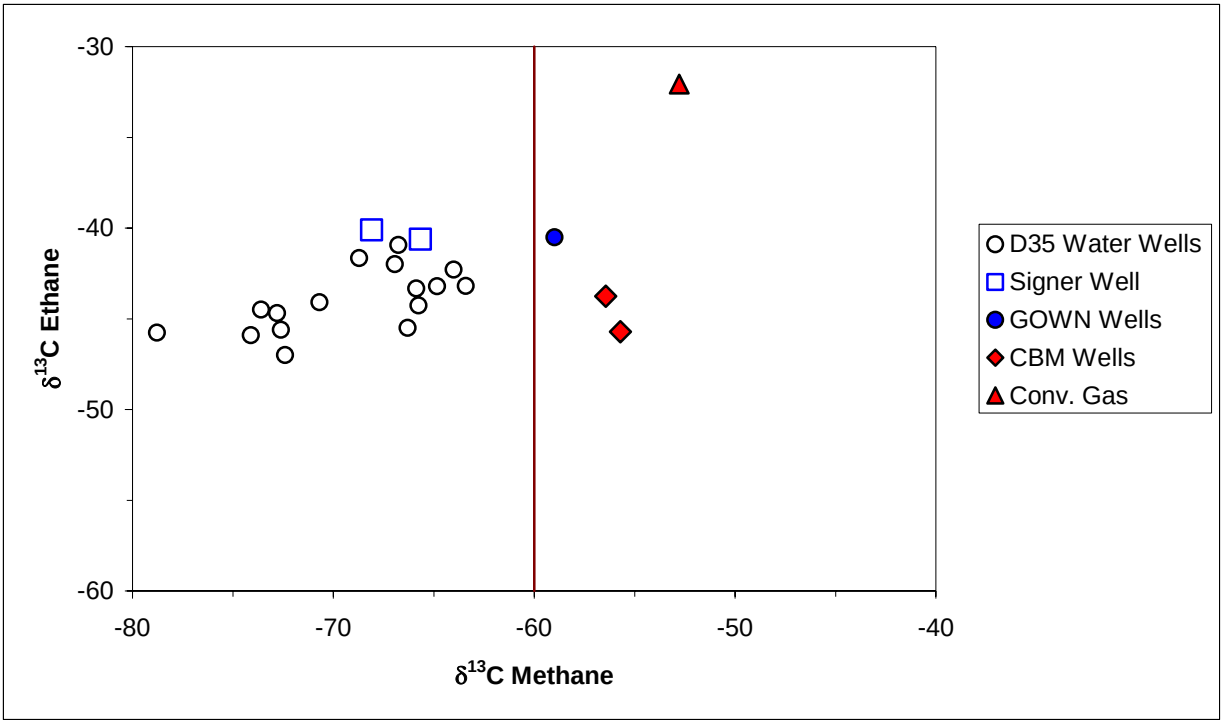


Figure 12 $\delta^{13}C$ Methane versus $\delta^{13}C$ Ethane.

A plot of the carbon isotopes of coexisting methane and CO_2 from water wells are presented on Figure 13. Lines of equal carbon isotope fractionation (α) between methane and CO_2 are shown. This line represents the isotopic difference between these coexisting pairs of carbon species (methane and carbon dioxide). Data above the α=1.055 line can be indicative of methane origination from the CO_2 reduction pathway (biogenic) while data below this line can be indicative of methane origination from the fermentation pathway (Whiticar et al. 1986). The data indicates that methane from the Signer well and the majority of D35 well originates from the microbial reduction of CO_2 (i.e. biogenic origin).

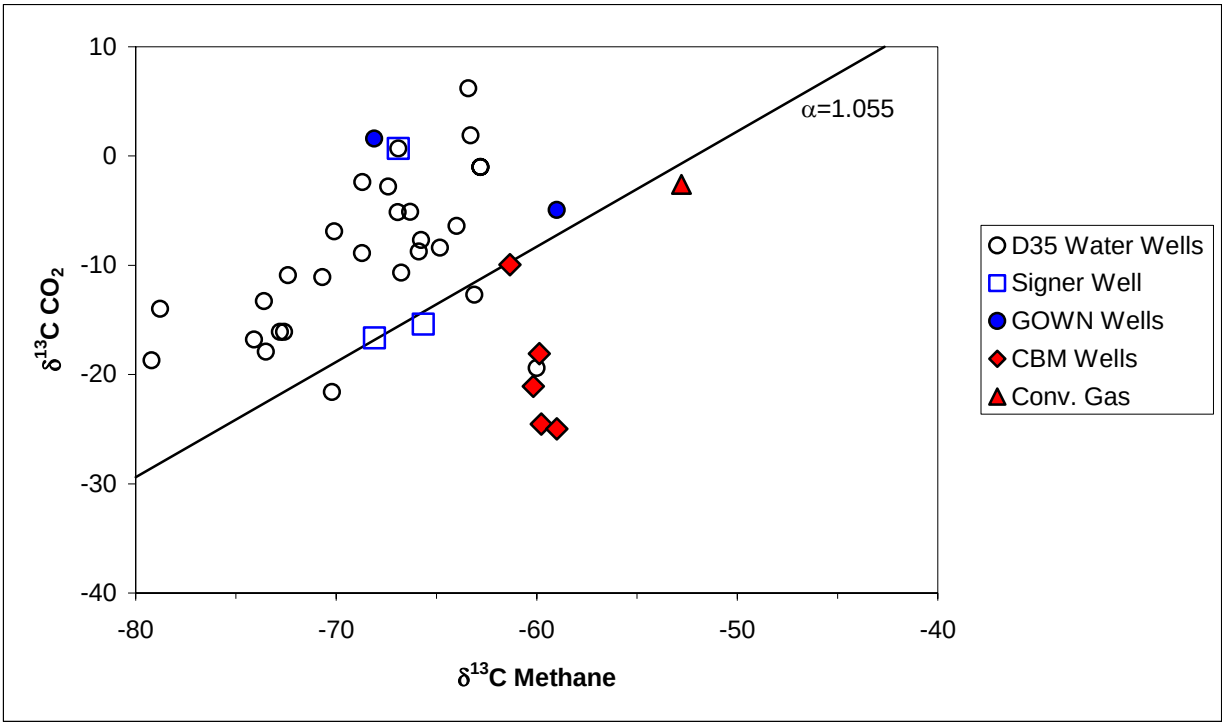


Figure 13 $\delta^{13}C$ Methane versus $\delta^{13}C$ CO_2. The α value is a line of equal fractionation between methane and CO_2.

Both the hydrocarbon gas composition and the isotopic signatures can be a result of mixing between different sources of gases (such as biogenic methane with thermogenic methane). These hypothetical mixing curves can be calculated using the equations of Jenden et al. (1993) shown on Figure 14. The y-axis of this plot is the ratio of methane to all other hydrocarbon gases.

For this mixing calculation three different end member gases were considered : the statistical average biogenic gas in the area (from the D35 wells), a gas with an isotopic signature similar to the Signer well, and typical CBM gas.

The first mixing scenario (curve 1) was the average biogenic gas found in the D35 water well ([Methane=437104 ppm], $\delta^{13}C_{methane}$=-68.7 ‰) mixed with a typical CBM gas ([Methane=876700 ppm], $\delta^{13}C_{methane}$=-55.7 ‰). The second scenario (curve 2) started with a methane concentration similar to the Signer well (834260 ppm) with a methane isotopic signature ($\delta^{13}C_{methane}$=-68 ‰) chosen so the Signer well would fall on the curve, mixed with the CBM gas. The tick marks on the curves represent mixtures of CBM gas with the gas from water wells, ranging from 0% to 100%

The Signer well mixing curve 2 shows a possible 0.6% mix of the CBM member with a biogenic end-member (chosen to fall though the well). While this is possible, the gas composition and $\delta^{13}C_{methane}$ value of the Signer well is not statistically any different from the average D35 water well (discussed below).

A similar plot can be constructed for ethane. This plot is not shown as the Signer well had ethane concentrations below the method detection limit for isotopic analysis.

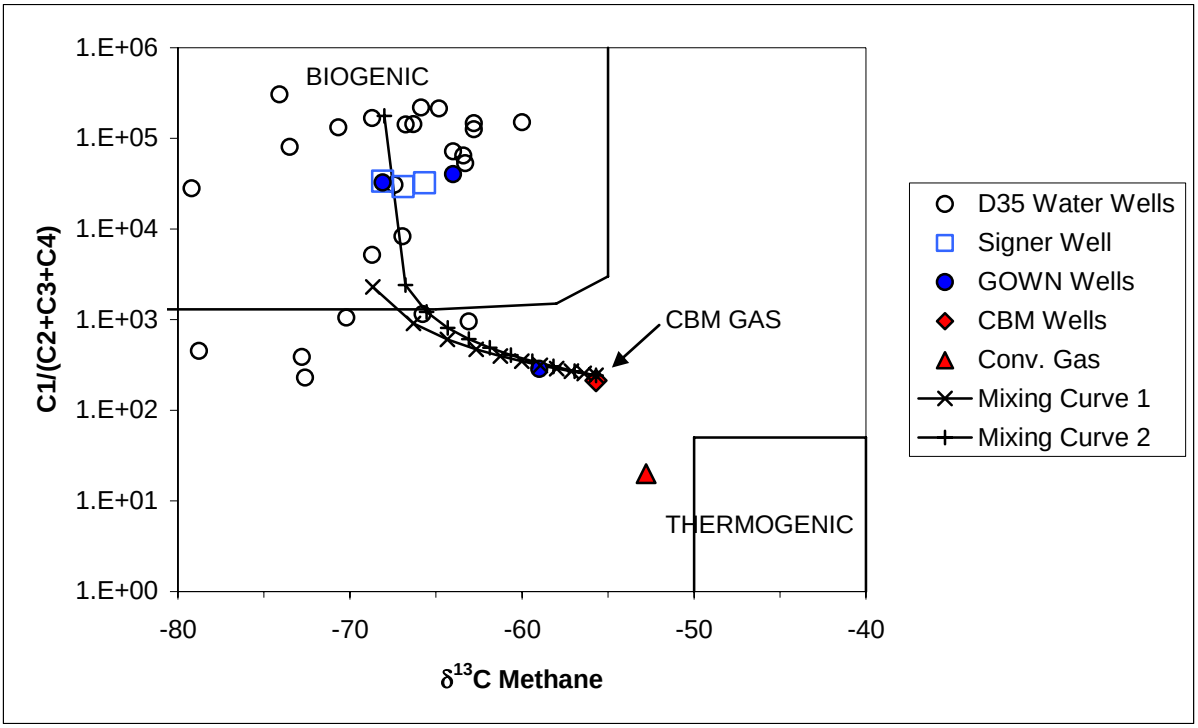


Figure 14 Mixing plot of $\delta^{13}C$ of methane versus the methane/C2+ ratio. Data for the bacterial and thermogenic fields are from Faber and Stahl 1984.

A statistical analysis was performed on gas concentration and gas carbon isotope data. The concentration of methane, ethane and propane along with the carbon isotope values of methane and ethane from water wells containing methane were compared to the Signer water well and the CBM wells (Table 5). Hydrocarbon gases were detected in 36 of 145 (25%) of the wells in the Rosebud and Redland area.

Student T-Tests were used to compare methane concentrations in the Signer well with the surrounding D35 water wells. T-Tests are based on a t-distribution, which is similar to a normal distribution, but is dependent upon the number of samples measured. There is no significant difference between the mean methane concentrations in the Signer well with that of the D35 water well (5% level of significance). This statistically validates the contention that the methane concentrations in the Signer well is the same as that of surrounding D35 water wells

Ethane concentrations were detected by gas chromatography in 10 of 145 (7%) water wells tested. Of these ten wells, the average concentration was 619 ppm as compared to 3798 ppm in the CBM wells. These results indicate a different source for etjhane or a small mixing ratio. Ethane carbon isotopes were measured in 16 wells by mass spectrometry, a more sensitive technique than gas chromatography. Propane and butane were not detected (by gas chromatography) in any of the water wells as compared to 559 ppm and 351 respectively in the CBM wells. The propane and butane carbon isotopes were measured in two water wells but gas

concentrations were below the method detection limit and the isotopes results may not be accurate.

Student T-Tests were used to compare mean methane carbon isotope value in the Signer well with the surrounding D35 water wells and the CBM wells. There is no significant difference between the mean methane carbon isotope values in the Signer well with that of the D35 water well (5% level of significance). This statistically validates the observation that the carbon isotope value of the methane in the Signer water well is the same as the methane isotope signature of the surrounding D35 water wells.

There is a statistically significant difference between the mean methane carbon isotope values in the D35 wells with that of the CBM wells (5% level of significance). This statistically validates the observation that the carbon isotope values of the methane in the CBM wells is less depleted than the methane isotope signature of the surrounding water wells.

There is a statistically significant difference between the mean methane carbon isotope values in the Signer well with that of the CBM wells (5% level of significance). This statistically validates the observation that the carbon isotope values of the methane in the CBM wells is less depleted than the methane isotope signature of the Signer well.

Student T-Tests were used to compare mean ethane carbon isotope value in the D35 water wells and the CBM wells. There is no statistically significant difference between the mean ethane carbon isotope values in the D35 wells with that of the CBM wells (5% level of significance). This statistically validates the observation that the carbon isotope values of the ethane in the CBM wells are the same as the ethane isotope signatures of the surrounding water wells.

There is a statistically significant difference between the mean ethane carbon isotope values in the Signer well with that of the D35 wells (5% level of significance). This statistically validates the observation that the carbon isotope values of the ethane in the Signer well is less depleted than the ethane isotope signature of the D35 wells.

There is no statistically significant difference between the mean ethane carbon isotope values in the Signer well with that of the CBM wells (5% level of significance). This statistically validates the observation that the carbon isotope values of the ethane in the Signer well are similar to the ethane isotope signature of the CBM wells. This does not indicate the D35 and Signer water wells have been impacted by ethane from CBM wells. Some of the ethane carbon isotope analyses may have been performed on samples that had ethane concentrations below the method detection limit, so the values may be questionable. In addition, similarity between ethane isotope signatures would be expected as both the CBM wells and the D35 water wells are completed in the same formation (but different coal members) in the area.

Table 5. Statistical values and T-Tests of the gas and isotope data.

D35 Water Wells			
	[Methane] (ppm)	$\delta^{13}C_{Methane}$ (‰)	$\delta^{13}C_{Ethane}$ (‰)
n	45	30	16
Min	440	-79.20	-47.00
Max	1000000	-60.00	-40.94
Mean	599077	-68.25	-44.00
Std.	337965	4.78	1.73

Signer Water Wells			
	[Methane] (ppm)	$\delta^{13}C_{Methane}$ (‰)	$\delta^{13}C_{Ethane}$ (‰)
n	5	3	2
Min	739000	-68.09	-40.62
Max	932000	-65.66	-40.11
Mean	834260	-66.88	-40.37
Std.	69726	1.22	0.36

CBM Wells			
	[Methane] (ppm)	$\delta^{13}C_{Methane}$ (‰)	$\delta^{13}C_{Ethane}$ (‰)
n	14	11	3
Min	702700	-63.96	-45.72
Max	979100	-56.44	-40.51
Mean	889200	-60.09	-43.33
Std.	113421	2.04	2.63

T-Test	T-Test	Degees of Freedom	5% level of significance
Mean [Methane] D 35 and Signer	-1.539	48	no significant difference
Mean $\delta^{13}C_{Methane}$ D 35 and Signer	-0.488	31	no significant difference
Mean $\delta^{13}C_{Ethane}$ D 35 and Signer	-2.892	16	**significant difference**
Mean [Methane] D 35 and CBM Wells	-3.141	57	**significant difference**
Mean $\delta^{13}C_{Methane}$ D 35 and CBM Wells	-5.448	39	**significant difference**
Mean $\delta^{13}C_{Ethane}$ D 35 and CBM Wells	-0.573	17	no significant difference
Mean [Methane] Signer and CBM Wells	-1.006	17	no significant difference
Mean $\delta^{13}C_{Methane}$ Signer and CBM Wells	-5.405	12	**significant difference**
Mean $\delta^{13}C_{Ethane}$ Signer and CBM Wells	1.505	3	no significant difference

5 SUMMARY AND CONCLUSIONS

Alberta Research Council's review of the AENV Signer complaint file and AEUB data, and independent review of additional data and aspects of the complaint, provides the following conclusions:

- The Signer water well is completed in the Upper Horseshoe Canyon Formation as are some of the upper perforations of the CBM wells. Local water wells appear to be predominantly producing water from the Carbon Thompson and Weaver coals of the Horseshoe Canyon Formation.
- In the Rosebud area, the deep GOWN well and CBM drilling and completions records indicate that the coals are not water saturated below the Weaver coal. Under natural conditions, flow between water saturated coals where water wells are completed and CBM coal zones is expected to be very limited.
- A local stress analysis indicates the most likely azimuth (orientation) of fractures and face cleats in the coal would be about 055° (Bachu and Michael 2002). No energy wells (within 2 km) line up on the 055° azimuth to the Signer well.
- Energy Wells in the vicinity (within 1.5 km) of the Signer well have no apparent drilling and construction issues that would contribute to methane or degradation of water quality in the Signer well.
- The CBM well 00/05-14-027-22 W4M, located about 1.7 km north of the Signer well, had perforations and fracturing in the same aquifer that the Signer well is completed. The connection between these wells has since been removed (cement squeezed) and it is unlikely that these short-lived perforations had any measurable effects on the Signer well.
- Records in the AENV well complaint file indicate the Signer well is not regularly shock chlorinated. Bacterial analyses show the presence of total coliform bacteria in exceedance of the maximum acceptable concentration on six different sampling events. The coliform bacteria were too numerous to count on three occasions. A pink microbial "slime" was noted in the well and cistern. In addition to several bacteria, amoebae, flagellates, ciliates and possible water fleas were observed in the well.
- The well and cistern have a severe bacterial/microbial problem that is likely indicative of leakage of water from ground surface entering the well. It is likely that the source of contamination is quite close to the Signer well, rather than from other sources such as drilling fluids that were surface-water sourced, because many of these organisms generally do not possess the ability to persist long in groundwater environment.
- An estimate of downward vertical gradient between the Signer well and the Horseshoe Canyon CBM zones is 1.0. This represents a large downward vertical gradient. If these two zones become connected, water would flow downwards towards the deeper CBM zone well rather than up into the Signer water well.
- A theoretical evaluation of the potential migration of methane as bubbles from the CBM well to the Signer well (through an induced fracture) suggests that the downward flow of groundwater in the fracture would stop the upward migration of methane bubbles.

- A 3.6 m fluctuation in static water level was observed in the Signer well. The cause of this decrease is unknown but possible causes include groundwater resource extraction by the Signer well or nearby users or from drought. This drop in water level, and corresponding drop in pressure on the coal zone, can be shown to contribute to the increase in amount of methane dissolved in the groundwater at saturation. This effect would be even greater during regular pumping of this well where the water level drops by up to 18 m.
- The water well major ion chemistry for the Signer wells is Na-HCO_3-Cl type water. The analyses show the Signer well consistently exceeds the aesthetic objectives for total dissolved solids (TDS) and sodium. As well, the aesthetic objective for chloride and iron are occasionally exceeded. This water chemistry is typical of water wells in the area.
- For all the D35 wells in the area sodium-bicarbonate (Na-HCO_3) and sodium-bicarbonate-chloride (Na-HCO_3-Cl) type waters are associated with the presence of methane in the water. The Signer water well chemistry is not unique. It, along with many other wells in the area, has Na-HCO_3-Cl type water.
- The methane carbon isotope values for the Signer well generally fall within the histogram distribution peak for methane values for all D35 wells in the area.
- The CBM wells have $\delta^{13}C$ methane values that are less depleted than the typical range (-60 to -80 ‰) for biogenic methane. This value represents a mixed thermogenic and biogenic origin.
- The water well data, including the Signer well, all have $\delta^{13}C$ methane values that are clearly biogenic. This means the methane likely formed at a shallow depth.
- The ethane carbon isotope values for the CBM wells generally fall within the histogram distribution peak for ethane values for all water wells in the area.
- The $\delta^{13}C$ ethane values of all the water wells are similar to the values of the CBM wells, but concentrations are lower (indicating a different origin or potential mixing, see next conclusion point).
- The hydrocarbon gas composition and isotopic values will be modified by mixing between different sources of gases. For example, a hypothetical mixing of 0.6 % CBM gas with a biogenic end-member could produce results similar to the Signer well. While gas mixing is possible, the gas composition and $\delta^{13}C_{methane}$ value of the Signer well is not statistically any different from the average D35 water well in the area.
- Student T-Tests statistically validate the observation that the carbon isotope signature of the methane in the Signer water well is the same as the methane isotope signature of the surrounding D35 water wells.
- Student T-Tests statistically validate the observation that the carbon isotope values of the methane in the CBM wells is different than the methane isotope signature of the surrounding water wells and the Signer well.
- Student T-Tests statistically validate the observation that the carbon isotope value of the ethane in the CBM wells is the same as the ethane isotope signature of the surrounding D35 water wells and the Signer well. This does not indicate the D35 and Signer water wells have been impacted by ethane from CBM wells. Some of the ethane carbon isotope analyses may have been performed on samples that had ethane concentrations below the method detection limit, so the values may be questionable. In addition,

similarity between ethane isotope signatures would be expected as both the CBM wells and the D35 water wells are completed in the same formation (but different coal members) in the area.

Overall Conclusion

- Alberta Research Council's overall conclusion of the evidence from the review of the AENV and AEUB files, along with a new review and evaluation of addition data and aspects, is that energy development projects in the area most likely have not adversely affected Ms. Signer's water well.

6 CLOSURE

This report details a thorough review of the AENV well complaint file for Ms. Signer regarding Coal Bed Methane (CBM) and conventional gas activities undertaken by EnCana and the subsequent perceived decrease in water quality of the Signer well.

This work was carried out in accordance with accepted hydrogeological practices.

Respectfully submitted,
Alberta Research Council
Permit to Practice P03619

Alexander R. Blyth, Ph.D., P. Geol.
Research Hydrogeologist

7 REFERENCES

Bachu, S., 1999, Flow systems in the Alberta Basin: Patterns, types and driving mechanisms. Bull. Canadian Petroleum Geology, v.47, no.4, p.455-474.

Bachu, A. and Michael, K., 2002. Hydrogeology and Stress Regime of the Upper Cretaceous-Tertiary Coal-Bearing Strata in Alberta. EUB/AGS Earth Sciences Report 2002-04.

Bachu, S. and Underschultz, J.R., 1995. Large-scale underpressuring in the Mississippian-Cretaceous succession, southwestern Alberta basin. American Association of Petroleum Geologists Bulletin, v. 7, p. 989-1004.

Beaton, A., Paňa, C., Chen, D., Wynn, D. and Langenberg, C.W., 2002. Coal and coalbed-methane potential of the upper Cretaceous – Tertiary strata, Alberta Plains. Alberta Energy and Utilities Board, Alberta Geological Survey, Earth Sciences Report 2002-06.

Binda, P.L., 1991. The Battle Formation: a lacustrine episode in the late Maastrichtian of western Canada: In: Aspects of nonmarine Cretaceous geology, N.J. Mateer and P.J. Chen (eds.), China Ocean Press, p. 202-217.

Borneuf, D., 1972. Hydrogeology of the Drumheller Area, Alberta. Research Council of Alberta, Report 72-1.

Coleman, D., Risatti, J. and Schoell, M., 1981. Fractionation of carbon and hydrogen isotopes by methane-oxidizing bacteria. Geochimica et Cosmochimica Acta, Vol. 45, p. 1033-1037.

Cullimore, R. and Johnston, L., 2005. Potential biological impact on shallow aquifers from using surface water as a drilling fluid. Scientific opinion report prepared by Droycon Bioconcepts Inc. for EnCana, September 9, 2005.

Decker, A.D., Klusman, R. and Horner, D.M., 1987. Geochemical techniques applied to the identification and disposal of connate coal water. Proceedings of the 1987 Coalbed Methane Symposium, Tuscaloosa, Alabama, p. 229-242.

Demchuk, T.D. and L.V. Hills, 1991, A re-examination of the Paskapoo Formation in the central Alberta Plains: the designation of three new members; Bulletin of Canadian Petroleum Geology, v. 39, no. 3, p. 270–282.

Faber, E. and Stahl, W., 1984. Geochemical surface exploration for hydrocarbons in North Sea. The American Association of Petroleum Geologists Bulletin, Vol. 68, No. 3, p. 363-386.

Freeze, A.R. and Cherry, J.A., 1979. Groundwater. Prentice-Hall Inc., Englewood Cliffs, N.J. 604 p.

Health Canada, 2007. Summary of guidelines for Canadian drinking water quality.

Hitchon, B., 1969a, Fluid flow in the Western Canada Sedimentary Basin: 1. Effect of topography. Water Resources Research, vol. 5, no. 1, pp. 186-195.

Hitchon, B., 1969b, Fluid flow in the Western Canada Sedimentary Basin: 2. Effect of geology. Water Resources Research, vol. 5, no. 2, pp. 460-469.

Hydrogeological Consultants Ltd., 1999. Water wells that breathe. Report to the Canadian Groundwater Association. August 11, 1999.

Hydrogeological Consultants Ltd., 2004. Redland Area 08-10-027-22 W4M Signer Domestic Water Well Investigation. Consulting report 04-512 to EnCana Corporation, November 2004.

HydroSolve Inc. 1996-2003. AQTESOLV, Aquifer Test Design and Analysis computer software, Version 3.50 Professional.

Jenden, P.D., Drazan, D.J. and Kaplan, I.R., 1993. Mixing of thermogenic natural gases in Northern Appalachian basin. The Americal Association of Petroleum Geologists Bulletin, V. 77, no. 6, pp. 980-998.

Jerzykiewicz, T., 1997, Stratigraphic framework of the uppermost Cretaceous to Paleocene strata of the Alberta Basin; Geological Survey of Canada, Bulletin 510, 121 p.

Macdonald, D.E., Ross, T.C., McCabe, P.J. and Bosman, A., 1987. An evaluation of the coal resources of the Belly River Group, to a depth of 400 m, in the Alberta Plains. Alberta Research Council, Open File Report 1987-8, 76 p.

Mossop, G.D. and Shetsen, I. (compilers) 1994. Geological atlas of the Western Canada Sedimentary Basin. Calgary, Canadian Society of Petroleum Geologists and Alberta Research Council, 510 p.

Parks, K.P. and Tóth, J., 1995. Field evidence for erosion-induced underpressuring in Upper Cretaceous and Tertiary strata, west central Alberta, Canada. Canadian Petroleum Geology Bulletin, v. 43, n. 3, p. 281-292.

Rice, D.D., 1993. Composition and origins of coalbed gas. In: B.E. Law and D.D. Rice (eds.), Hydrocarbons from coal: AAPG Studies in Geology 38, p. 159-184.

Schoell, M., 1980. The hydrogen and carbon isotopic composition of methane from natural gases of various origins. Geochimica et Cosmochimica Acta, Vol. 44, p. 649-661.

Schoell, M., 1983. Genetic characterization of natural gases. American Association of Petroleum Geologists Bulletin, Vol. 67, No. 12, p. 2225-2238.

Sweet, A.R. and D.R. Braman, 1992, The K-T boundary and contiguous strata in western Canada: interactions between paleoenvironments and palynological assemblages; Cretaceous Research, v. 13, p. 31–79.

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

Van Voast, W., 2003. Geochemical signature of formation water associated with coalbed methane. American Association of Petroleum Geologists Bulletin, Vo. 87, No. 4, p. 667-676.

Whiticar, M.J., Faber, E. and Schoell, M., 1986. Biogenic methane formation in marine and freshwater environments: CO2 reduction vs. acetate fermentation – Isotopic evidence. Geochimica et Cosmochimica Acta, Vol. 50, p. 693-709.

APPENDIX A

SUMMARY OF ENERGY WELL DRILLING AND COMPLETION DETAILS

Well info for Alberta Research Council request

20-Apr-2006

all wells within 1600m of Lauridsen and Ernst water wells

Well Head (/00 event sequence)	Spud Date	Rig Release	Lost circulation (Y/N)	Surface Casing Depth (m)	TD (m)	Cement returns (surface casing) (m3)	Cement returns (prod casing) (m3)	Perf Count	Perf date	Perf top (mKb)	Perf bottom (mKb)	Frac Count	Frac Date	Frac Top (mKb)	Frac Bottom (mKb)	Frac fluid
100/07-11-027-22W4/00	07-Dec-02	09-Dec-02	N	144	1287	1.00	7	11	13-Apr-05	342.8	343.8	2	24-May-04	636.0	639.0	NITRIFIED FOAM
									13-Apr-05	299.4	300.4		02-May-05	175.9	343.8	N2
									13-Apr-05	337.0	338.0					
									20-Apr-04	636.0	639.0					
									13-Apr-05	272.7	273.7					
									13-Apr-05	296.4	297.4					
									17-Jan-03	1188.5	1191.5					
									13-Apr-05	211.9	214.9					
									13-Apr-05	175.9	177.9					
									08-Jun-04	604.0	607.0					
									13-Apr-05	188.0	189.0					
100/04-11-027-22W4/00	29-Oct-97	30-Oct-97	N	20	771	0.7	1	2	17-Nov-97	669.0	672.0	1	24-Nov-97	669.0	672.0	N2
									27-Nov-97	616.5	619.5					
102/04-11-027-22W4/00	21-Jan-04	21-Jan-04	N	43	504	0.2	1.1	10	22-Apr-04	302.5	303.5	1	03-Jun-04	190.5	373.5	N2
									22-Apr-04	334.9	335.9					
									22-Apr-04	190.5	191.5					
									22-Apr-04	372.5	373.5					
									22-Apr-04	308.4	309.4					
									22-Apr-04	332.3	333.3					
									22-Apr-04	212.1	214.1					
									22-Apr-04	208.7	209.7					
									22-Apr-04	192.1	193.1					
									22-Apr-04	248.1	251.1					
100/14-02-027-22W4/00	28-Feb-95	03-Mar-95	N	45	756	0.02	2	2		615.0	618.0					
									29-Jul-95	664.0	668.0					
102/14-02-027-22W4/00	07-Oct-03	07-Oct-03	N	43	472	0.2	1.5	13	11-Feb-04	331.1	332.1	1	27-Feb-04	162.9	372.7	N2
									11-Feb-04	306.6	307.6					
									11-Feb-04	302.1	303.1					
									11-Feb-04	214.3	217.3					
									11-Feb-04	211.4	212.4					
									11-Feb-04	333.3	334.3					
									11-Feb-04	200.4	201.4					
									11-Feb-04	193.6	196.6					
									11-Feb-04	254.2	255.2					
									11-Feb-04	371.7	372.7					
									11-Feb-04	162.9	163.9					
									11-Feb-04	190.8	191.8					
									11-Feb-04	247.6	250.6					
103/14-02-027-22W4/00	17-Aug-04	19-Aug-04	N	144	1326	0.8	6	9	17-Feb-05	615.0	618.0					
									17-Feb-05	613.5	614.5					
									26-Feb-05	543.0	544.0					
									25-Oct-04	1226.0	1229.0					
									09-Jan-05	671.5	676.0					
									03-Mar-05	501.0	502.0					
									16-Jan-05	646.0	650.0					
									17-Feb-05	620.0	624.5					
									25-Oct-04	1223.0	1226.0					
100/10-03-027-22W4/00	18-Jun-95	20-Jun-95	N	44	764	0.7	1	2	29-Jul-95	680.0	683.0					
									29-Jul-95	673.0	678.0					
102/10-03-027-22W4/00	19-May-02	20-May-02	N	64	462	0.3	3	13	28-Jun-02	196.2	199.2					
									28-Jun-02	382.3	383.3					
									28-Jun-02	261.7	262.7					
									28-Jun-02	218.8	221.8					
									28-Jun-02	343.1	344.1					
									28-Jun-02	311.4	312.4					
									28-Jun-02	256.2	258.2					
									28-Jun-02	228.3	229.3					
									28-Jun-02	341.0	342.0					
									28-Jun-02	214.2	215.2					
									28-Jun-02	203.1	204.1					
									28-Jun-02	254.2	256.2					
									28-Jun-02	316.8	317.8					
100/16-02-027-22W4/00	14-Aug-04	16-Aug-04	N	143	1326	0	5	15	28-Mar-05	246.3	249.3	1	02-May-05	191.4	377.3	N2
									28-Mar-05	210.1	211.1					
									22-Jan-05	584.5	586.0					
									28-Mar-05	233.0	234.0					
									15-Sep-04	1223.5	1225.5					
									28-Mar-05	308.3	309.3					
									28-Mar-05	376.3	377.3					
									28-Mar-05	334.1	335.1					
									28-Mar-05	372.9	373.9					
									28-Mar-05	191.4	192.4					
									15-Sep-04	1225.5	1228.0					
									28-Mar-05	214.3	216.3					
									28-Mar-05	193.6	196.6					
									28-Mar-05	300.6	301.6					
									28-Mar-05	205.8	206.8					
102/16-02-027-22W4/00			N	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A							
100/06-02-027-22W4/00	18-Aug-89	24-Aug-89	N	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A							
102/06-02-027-22W4/00	27-Oct-03	07-Nov-03	N	150	1331		5	7	26-Apr-04	600.0	601.0					
									26-Feb-04	646.0	650.0					
									26-Feb-04	637.0	638.5					
									19-Feb-04	670.0	671.5					
									13-Jan-04	1221.5	1223.0					
									26-Feb-04	640.0	643.0					
									13-Jan-04	1225.0	1229.0					
103/06-02-027-22W4/00	14-May-05	25-May-05	N	69	754	1	2	16	30-Aug-05	311.1	312.1	1	22-Sep-05	191.5	654.9	N2
									30-Aug-05	213.9	214.4					
									30-Aug-05	377.5	378.0					
									30-Aug-05	217.0	219.0					
									30-Aug-05	654.4	654.9					
									04-Jul-05	498.5	499.5					
									30-Aug-05	389.4	389.9					
									16-Jul-05	235.0	239.0					
									30-Aug-05	248.8	251.8					
									04-Jul-05	500.5	503.5					
									30-Aug-05	306.5	307.0					
									10-Jul-05	256.5	264.0					
									30-Aug-05	196.0	197.0					
									30-Aug-05	197.5	198.5					
									30-Aug-05	191.5	192.0					
									30-Aug-05	227.4	227.9					

Well info for Alberta Research Council request

20-Apr-2006

all wells within 1600m of Lauridsen and Ernst water wells

Well Head (/00 event sequence)	Spud Date	Rig Release	Lost circulation (Y/N)	Surface Casing Depth (m)	TD (m)	Cement returns (surface casing) (m3)	Cement returns (prod casing) (m3)	Perf Count	Perf date	Perf top (mKb)	Perf bottom (mKb)	Frac Count	Frac Date	Frac Top (mKb)	Frac Bottom (mKb)	Frac fluid
100/13-11-027-22W4/00	16-Jun-03	18-Jun-03	N	140	1342	2	1	2	11-Aug-03	682.5	684.0					
									17-Jul-03	1234.0	1236.0					
100/16-11-027-22W4/00	20-May-00	06-Jun-00	N	200	1463	0.5		2	29-Jul-00	1211.0	1214.0					
									15-Jul-00	1431.5	1433.0					
100/15-10-027-22W4/00	04-Jun-03	07-Jun-03	N	135	1548	2	4	3	04-Dec-03	718.0	720.0					
									23-Oct-03	1414.0	1417.0					
									13-Aug-03	1498.0	1500.0					
100/04-12-027-22W4/00	26-Jul-04	30-Jul-04	N	142	1438	0	6	5	17-Feb-05	602.0	603.0					
									29-Oct-04	1314.6	1320.5					
									11-Feb-05	666.0	670.0					
									11-Feb-05	671.0	673.5					
									17-Feb-05	604.0	605.0					
100/06-12-027-22W4/00	20-Jul-98	21-Jul-98	N	#N/A	751	#N/A	4	21	31-Jul-03	186.0	187.0	2	07-Sep-98	565.0	568.0	N2
									15-Sep-98	565.0	568.0		29-Sep-98	565.0	566.0	N2
									31-Jul-03	231.5	234.5					
									31-Jul-03	366.0	368.0					
									31-Jul-03	287.0	288.0					
									31-Jul-03	199.0	202.0					
									31-Jul-03	376.0	377.0					
									31-Jul-03	217.0	218.0					
									31-Jul-03	363.0	364.0					
									31-Jul-03	355.0	356.0					
									31-Jul-03	208.5	209.5					
									31-Jul-03	293.0	295.0					
									31-Jul-03	368.0	370.0					
									31-Jul-03	360.5	361.5					
									31-Jul-03	372.0	373.0					
									30-Aug-98	653.0	657.0					
									31-Jul-03	238.0	239.0					
									31-Jul-03	190.0	192.0					
									31-Jul-03	196.0	197.0					
									31-Jul-03	214.0	215.0					
									31-Jul-03	318.5	321.5					
102/06-12-027-22W4/00	31-Jan-02	04-Feb-02	N	202	1464	1	0.5	3	23-Feb-02	1208.0	1209.0					
									23-Feb-02	1210.0	1211.0					
									12-Feb-02	1398.0	1401.0					
100/08-12-027-22W4/00	07-Dec-02	09-Dec-02	N	132	1294	0.5	8	4	29-May-04	605.0	612.0					
									01-Feb-03	1192.5	1195.0					
									17-Jan-03	1207.5	1209.0					
									03-May-04	617.5	622.5					
102/08-12-027-22W4/00	22-Jan-04	22-Jan-04	N	43	503	0.2	1	14	27-Apr-04	280.2	282.2	1	24-Jun-04	163.0	399.3	N2
									27-Apr-04	204.3	205.3					
									27-Apr-04	163.0	167.0					
									27-Apr-04	186.0	188.0					
									27-Apr-04	194.6	195.6					
									27-Apr-04	305.4	306.4					
									27-Apr-04	344.5	345.5					
									27-Apr-04	350.2	351.2					
									27-Apr-04	307.2	308.2					
									27-Apr-04	181.1	182.1					
									27-Apr-04	169.5	170.5					
									27-Apr-04	398.3	399.3					
									27-Apr-04	217.2	220.2					
									27-Apr-04	176.8	177.8					
100/14-12-027-22W4/00	26-Jun-03	29-Jun-03	N	159	1456	1	3	3	20-Sep-03	1426.0	1428.5					
									11-Nov-03	1205.5	1207.0					
									31-Jul-03	1426.5	1428.0					
100/04-13-027-22W4/00	05-Feb-05	08-Feb-05	N	162	1467	2	6	1	17-Feb-05	1209.0	1212.0					
100/07-13-027-22W4/00	26-Jul-98	27-Jul-98	N	#N/A	744	#N/A	1	1	05-Sep-98	648.0	654.0	1	09-Sep-98	0.0	0.0	N2
102/07-13-027-22W4/00	22-May-02	24-May-02	N	194	1482	0.5	3	2	15-Oct-02	1206.0	1208.0					
									06-Jun-02	1438.0	1442.5					
100/12-13-027-22W4/00	17-Jul-03	20-Jul-03	N	140	1367		4	1	18-Oct-03	1263.0	1265.0					
100/15-13-027-22W4/00	18-Jun-03	21-Jun-03	N	162	1481	2	3	4	20-Sep-03	1216.0	1219.0					
									31-Jul-03	1459.5	1461.0					
									29-Aug-03	1399.5	1402.0					
									29-Aug-03	1404.5	1406.0					
100/03-14-027-22W4/00	06-Jul-05	06-Jul-05	N	66	746	0.5	2	20	27-Feb-06	378.0	379.0	2	14-Aug-05	621.5	645.0	N2
									27-Feb-06	238.8	239.8		02-Mar-06	201.4	857.6	N2
									27-Feb-06	201.4	202.0					
									27-Feb-06	508.7	509.7					
									24-Jul-05	644.0	645.0					
									27-Feb-06	373.1	374.1					
									09-Sep-05	248.5	251.0					
									27-Feb-06	324.3	325.3					
									27-Feb-06	301.9	302.9					
									27-Feb-06	237.6	238.6					
									24-Jul-05	621.5	623.5					
									27-Feb-06	367.9	368.9					
									27-Feb-06	656.6	657.6					
									27-Feb-06	204.5	205.5					
									25-Sep-05	223.0	225.0					
									27-Feb-06	212.6	213.6					
									27-Feb-06	207.5	208.5					
									27-Feb-06	205.7	206.7					
									27-Feb-06	649.9	650.9					
									04-Sep-05	416.0	418.0					
102/03-14-027-22W4/00			N	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A							
100/08-14-027-22W4/00	10-Jun-98	26-Jul-98	N	#N/A	759	#N/A	1	1	05-Sep-98	569.0	572.0					
100/01-24-027-22W4/00	27-Jul-98	28-Jul-98	N	#N/A	762	#N/A	1	1	21-Nov-98	430.0	433.0	1	26-Nov-98	430.0	433.0	N2
100/11-07-027-21W4/00	04-Jun-94	14-Jun-94	N	308	1501	#N/A	#N/A	5	27-Jun-94	1387.5	1389	3	05-Jul-94	1210.0	1212.0	
									15-Jul-94	654	659		10-Jul-94	1210.0	1212.0	
									27-Jun-1994	1388.5	1389		17-Jul-94	654.0	659.0	
									14-Jul-1994	654	659					
									28-Jun-94	1210	1212					
100/07-18-027-21W4/00	16-Aug-1974	25-Aug-1974	N	151	632	#N/A	#N/A	2	18-Jun-97	591.9	594.4					
									05-Sep-1974	591.9	594.4					

APPENDIX B
WATER WELL DRILLING REPORTS

Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.:	0299882
Map Verified:	Not Verified
Date Report Received:	2002/05/06
Measurements:	Imperial

1. Contractor & Well Owner Information

Company Name: GERRITSEN DRILLING		Drilling Company Approval No.: 118135
Mailing Address: BOX 187	City or Town: ROCKYFORD ALBERTA CANADA	Postal Code: T0J 2R0
WellOwner's Name: SIGNER, DEBBIE	Well Location Identifier:	
P.O. Box Number:	Mailing Address: 916 EAST CHESTERMERE DR,	Postal Code: T1X 1A8
City: CHESTERMERE	Province: AB	Country: CA

2. Well Location

1/4 or LSD	Sec	Twp	Rge	Westof M
SE	10	027	22	4

Location in Quarter
0 FT from S Boundary
0 FT from W Boundary

Lot Block Plan

Well Elev: FT
How Obtain: Not Obtain

3. Drilling Information

Type of Work: New Well
Reclaimed Well
Date Reclaimed:
Materials Used: Unknown

Proposed well use: Domestic
Anticipated Water Requirements/day 300 Gallons

Method of Drilling: Rotary

Flowing Well: No
Gas Present: No
Rate: Gallons
Oil Present: No

4. Formation Log

Depth from ground level (feet)	Lithology Description
17	Tan Till
21	Brown Fine Grained Gravel
42	Blue Till & Clay
123	Blue Till & Rocks
126	Blue Clay
177	Blue Shale
181	Coal
184	Dark Gray Shale

5. Well Completion

Date Started(yyyy/mm/dd): 2002/02/05	Date Completed(yyyy/mm/dd): 2002/02/07
Well Depth: 184 FT	Borehole Diameter: 0 Inches
Casing Type: Plastic	Liner Type: Plastic
Size OD: 6 Inches	Size OD: 4.5 Inches
Wall Thickness: 0.38 Inches	Wall Thickness: 0.237 Inches
Bottom at: 135 FT	Top: 124 FT Bottom: 184 FT

Perforations	Perforations Size:
from: 174 FT to: 184 FT	0.187 Inches x 3 Inches
from: 0 FT to: 0 FT	0 Inches x 0 Inches
from: 0 FT to: 0 FT	0 Inches x 0 Inches

Perforated by: Saw

Seal: Driven & Bentonite
from: 0 FT to: 135 FT
Seal: Unknown
from: 0 FT to: 0 FT
Seal: Benseal
from: 0 FT to: 0 FT

Screen Type: Unknown	Screen ID: 0 Inches
from: 0 FT to: 0 FT	Slot Size: 0 Inches
Screen Type: Unknown	Screen ID: 0 Inches
from: 0 FT to: 0 FT	Slot Size: 0 Inches

Screen Installation Method: Unknown

Fittings
Top: Unknown Bottom: Unknown

Pack: Unknown
Grain Size: Amount: Unknown

Geophysical Log Taken:
Retained on Files:

Additional Test and/or Pump Data
Chemistries taken By Driller: No
Held: 0 Documents Held: 3

Pitless Adapter Type:
Drop Pipe Type:
Length: FT Diameter: Inches

Comments:
DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: 27".

6. Well Yield

Test Date (yyyy/mm/dd): 2002/02/07	Start Time: 11:00 AM
Test Method: Pump	
Non pumping static level:	20.407 FT
Rate of water removal:	1.66 Gallons/Min
Depth of pump intake:	184.7 FT
Water level at end of pumping:	80.9 FT
Distance from top of casing to ground level:	27 Inches

Depth To water level (feet) Drawdown	Elapsed Time Minutes:Sec	Recovery
20.407	0:00	74.245
22.835	2:00	71.785
24.344	4:00	69.783
24.475	6:00	67.88
22.31	8:00	66.109
25.459	10:00	64.436
34.186	12:00	62.861
37.664	14:00	61.352
40.322	16:00	59.974
42.716	18:00	58.629
45.013	20:00	57.382
47.146	22:00	56.201
49.114	24:00	55.085
50.984	26:00	54.035
52.723	28:00	53.051
54.429	30:00	52.1
55.971	32:00	51.214
57.448	34:00	50.361
58.727	36:00	49.541
59.941	38:00	48.786
61.056	40:00	48.064
62.238	42:00	47.375
63.32	44:00	46.719
64.239	46:00	46.096
65.289	48:00	45.505

Total Drawdown: 60.696 FT

If water removal was less than 2 hr duration, reason why:

Recommended pumping rate: 1.58 Gallons/Min

Recommended pump intake: 183.7 FT

Type Pump Installed
Pump Type:
Pump Model:
H.P.:

Any further pumptest information? No

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
Certification No.: 1

This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.

Signature Yr Mo Day

Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.:	0299882
Map Verified:	Not Verified
Date Report Received:	2002/05/06
Measurements:	Imperial

1. Contractor & Well Owner Information

Company Name: GERRITSEN DRILLING		Drilling Company Approval No.: 118135
Mailing Address: BOX 187	City or Town: ROCKYFORD ALBERTA CANADA	Postal Code: T0J 2R0
WellOwner's Name: SIGNER, DEBBIE	Well Location Identifier:	
P.O. Box Number:	Mailing Address: 916 EAST CHESTERMERE DR,	Postal Code: T1X 1A8
City: CHESTERMERE	Province: AB	Country: CA

2. Well Location

1/4 or LSD	Sec	Twp	Rge	Westof M
SE	10	027	22	4

Location in Quarter
0 FT from S Boundary
0 FT from W Boundary

Lot Block Plan

Well Elev: FT
How Obtain: Not Obtain

3. Drilling Information

Type of Work: New Well
Reclaimed Well
Date Reclaimed:
Materials Used: Unknown

Proposed well use: Domestic
Anticipated Water Requirements/day 300 Gallons

Method of Drilling: Rotary

Flowing Well: No
Gas Present: No
Rate: Gallons
Oil Present: No

4. Formation Log

Depth from ground level (feet)	Lithology Description

5. Well Completion

Date Started(yyyy/mm/dd): 2002/02/05	Date Completed(yyyy/mm/dd): 2002/02/07
Well Depth: 184 FT	Borehole Diameter: 0 Inches
Casing Type: Plastic	Liner Type: Plastic
Size OD: 6 Inches	Size OD: 4.5 Inches
Wall Thickness: 0.38 Inches	Wall Thickness: 0.237 Inches
Bottom at: 135 FT	Top: 124 FT Bottom: 184 FT

Perforations	Perforations Size:
from: 174 FT to: 184 FT	0.187 Inches x 3 Inches
from: 0 FT to: 0 FT	0 Inches x 0 Inches
from: 0 FT to: 0 FT	0 Inches x 0 Inches

Perforated by: Saw

Seal: Driven & Bentonite
from: 0 FT to: 135 FT
Seal: Unknown
from: 0 FT to: 0 FT
Seal: Benseal
from: 0 FT to: 0 FT

Screen Type: Unknown from: 0 FT to: 0 FT	Screen ID: 0 Inches Slot Size: 0 Inches
Screen Type: Unknown from: 0 FT to: 0 FT	Screen ID: 0 Inches Slot Size: 0 Inches

Screen Installation Method: Unknown

Fittings
Top: Unknown Bottom: Unknown

Pack: Unknown
Grain Size: Amount: Unknown

Geophysical Log Taken:
Retained on Files:

Additional Test and/or Pump Data
Chemistries taken By Driller: No
Held: 0 Documents Held: 3

Pitless Adapter Type:
Drop Pipe Type:
Length: FT Diameter: Inches

Comments:
DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: 27".

6. Well Yield

Test Date (yyyy/mm/dd): 2002/02/07	Start Time: 11:00 AM
Test Method: Pump	
Non pumping static level:	20.407 FT
Rate of water removal:	1.66 Gallons/Min
Depth of pump intake:	184.7 FT
Water level at end of pumping:	80.9 FT
Distance from top of casing to ground level:	27 Inches

Depth To water level (feet)

Drawdown	Elapsed Time Minutes:Sec	Recovery
66.109	50:00	44.948
67.06	52:00	44.422
67.782	54:00	43.898
68.537	56:00	43.406
69.258	58:00	42.946
69.948	60:00	42.52
70.768	62:00	42.093
71.358	64:00	41.699
71.982	66:00	41.306
72.638	68:00	40.912
73.163	70:00	40.584
73.688	72:00	40.256
74.212	74:00	39.928
74.836	76:00	39.6
75.262	78:00	39.304
75.689	80:00	39.009
76.05	82:00	38.747
76.476	84:00	38.484
76.87	86:00	38.222
77.264	88:00	37.992
77.657	90:00	37.762
77.953	92:00	37.533
78.281	94:00	37.303
78.609	96:00	37.106
78.871	98:00	36.909

Total Drawdown: 60.696 FT

If water removal was less than 2 hr duration, reason why:

Recommended pumping rate: 1.58 Gallons/Min

Recommended pump intake: 183.7 FT

Type Pump Installed
Pump Type:
Pump Model:
H.P.:

Any further pumptest information? No

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
Certification No.: 1

This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.

Signature Yr Mo Day

Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.:	0299882
Map Verified:	Not Verified
Date Report Received:	2002/05/06
Measurements:	Imperial

1. Contractor & Well Owner Information

Company Name: GERRITSEN DRILLING		Drilling Company Approval No.: 118135
Mailing Address: BOX 187	City or Town: ROCKYFORD ALBERTA CANADA	Postal Code: T0J 2R0
WellOwner's Name: SIGNER, DEBBIE	Well Location Identifier:	
P.O. Box Number:	Mailing Address: 916 EAST CHESTERMERE DR,	Postal Code: T1X 1A8
City: CHESTERMERE	Province: AB	Country: CA

2. Well Location

1/4 or LSD	Sec	Twp	Rge	Westof M
SE	10	027	22	4

Location in Quarter
0 FT from S Boundary
0 FT from W Boundary

Lot Block Plan

Well Elev: FT
How Obtain: Not Obtain

3. Drilling Information

Type of Work: New Well
Reclaimed Well
Date Reclaimed: Materials Used: Unknown

Proposed well use: Domestic
Anticipated Water Requirements/day 300 Gallons

Method of Drilling: Rotary

Flowing Well: No
Gas Present: No
Rate: Gallons
Oil Present: No

4. Formation Log

Depth from ground level (feet)	Lithology Description

5. Well Completion

Date Started(yyyy/mm/dd): 2002/02/05	Date Completed(yyyy/mm/dd): 2002/02/07
Well Depth: 184 FT	Borehole Diameter: 0 Inches
Casing Type: Plastic	Liner Type: Plastic
Size OD: 6 Inches	Size OD: 4.5 Inches
Wall Thickness: 0.38 Inches	Wall Thickness: 0.237 Inches
Bottom at: 135 FT	Top: 124 FT Bottom: 184 FT

Perforations	Perforations Size:
from: 174 FT to: 184 FT	0.187 Inches x 3 Inches
from: 0 FT to: 0 FT	0 Inches x 0 Inches
from: 0 FT to: 0 FT	0 Inches x 0 Inches

Perforated by: Saw

Seal: Driven & Bentonite
from: 0 FT to: 135 FT
Seal: Unknown
from: 0 FT to: 0 FT
Seal: Benseal
from: 0 FT to: 0 FT

Screen Type: Unknown from: 0 FT to: 0 FT	Screen ID: 0 Inches Slot Size: 0 Inches
Screen Type: Unknown from: 0 FT to: 0 FT	Screen ID: 0 Inches Slot Size: 0 Inches

Screen Installation Method: Unknown

Fittings
Top: Unknown Bottom: Unknown

Pack: Unknown
Grain Size: Amount: Unknown

Geophysical Log Taken:
Retained on Files:

Additional Test and/or Pump Data
Chemistries taken By Driller: No
Held: 0 Documents Held: 3

Pitless Adapter Type:
Drop Pipe Type:
Length: FT Diameter: Inches

Comments:
DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: 27".

6. Well Yield

Test Date (yyyy/mm/dd): 2002/02/07	Start Time: 11:00 AM
Test Method: Pump	
Non pumping static level:	20.407 FT
Rate of water removal:	1.66 Gallons/Min
Depth of pump intake:	184.7 FT
Water level at end of pumping:	80.9 FT
Distance from top of casing to ground level:	27 Inches

Depth To water level (feet) Drawdown	Elapsed Time Minutes:Sec	Recovery
79.232	100:00	36.712
79.495	102:00	
79.692	104:00	
79.987	106:00	
80.151	108:00	
80.315	110:00	
80.512	112:00	
80.643	114:00	
80.676	116:00	
80.577	118:00	
80.479	120:00	
80.413	122:00	
80.348	124:00	
80.249	126:00	
80.249	128:00	
80.184	130:00	
80.38	132:00	
80.61	134:00	
80.807	136:00	
80.938	138:00	

Total Drawdown: 60.696 FT

If water removal was less than 2 hr duration, reason why:

Recommended pumping rate: 1.58 Gallons/Min

Recommended pump intake: 183.7 FT

Type Pump Installed
Pump Type:
Pump Model:
H.P.:

Any further pumptest information? No

7. Contractor Certification

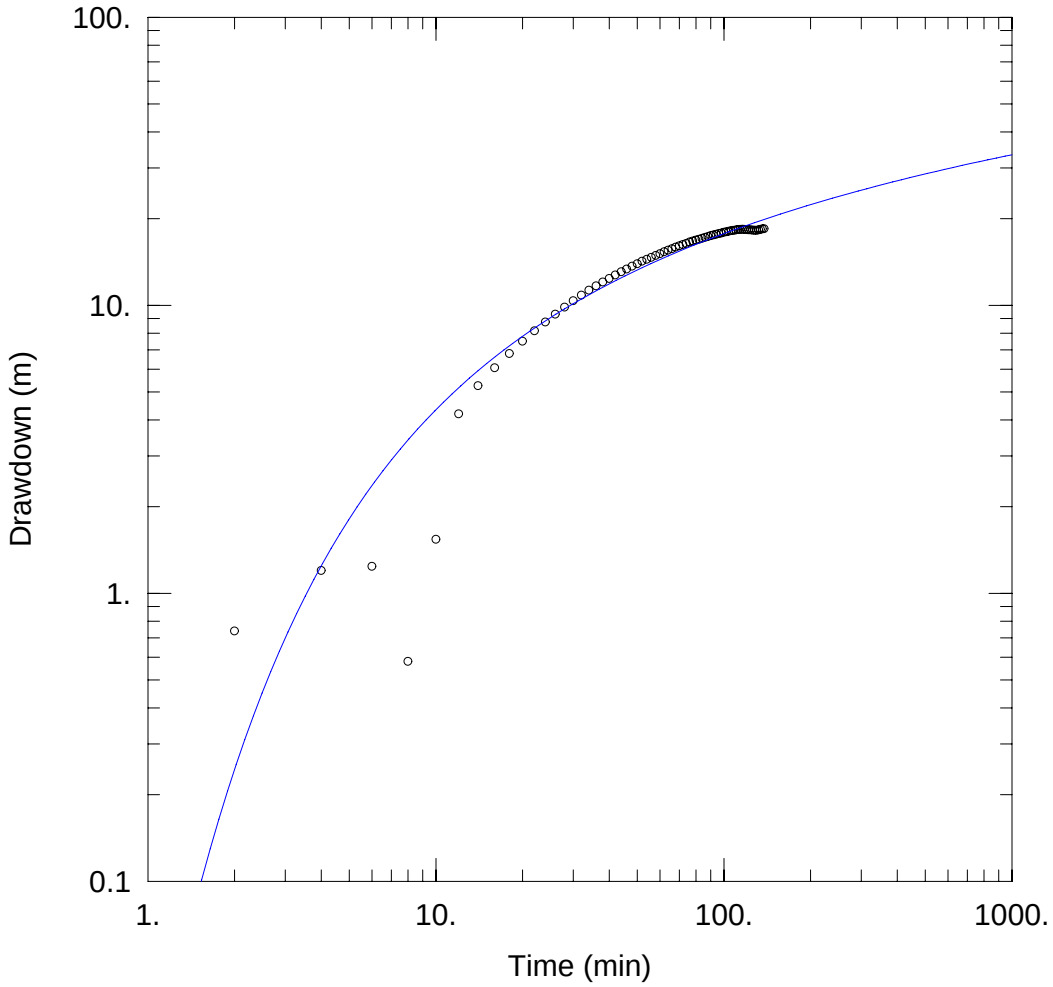
Driller's Name: UNKNOWN DRILLER
Certification No.: 1

This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.

Signature Yr Mo Day

APPENDIX C

PUMPING TEST GRAPHICAL SOLUTION



SIGNER WELL

Data Set: O:\hg\PROJECTS\2007-2008\Signer Well Complaint\Signer 02 Pumping Test.aqt
Date: 12/13/07 Time: 12:09:16

PROJECT INFORMATION

Company: Alberta Research Council
Client: Alberta Environment
Project: 8789017
Location: SE-10-027-22 W4M
Test Well: Signer Well
Test Date: February 7, 2002

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
Signer	0	0

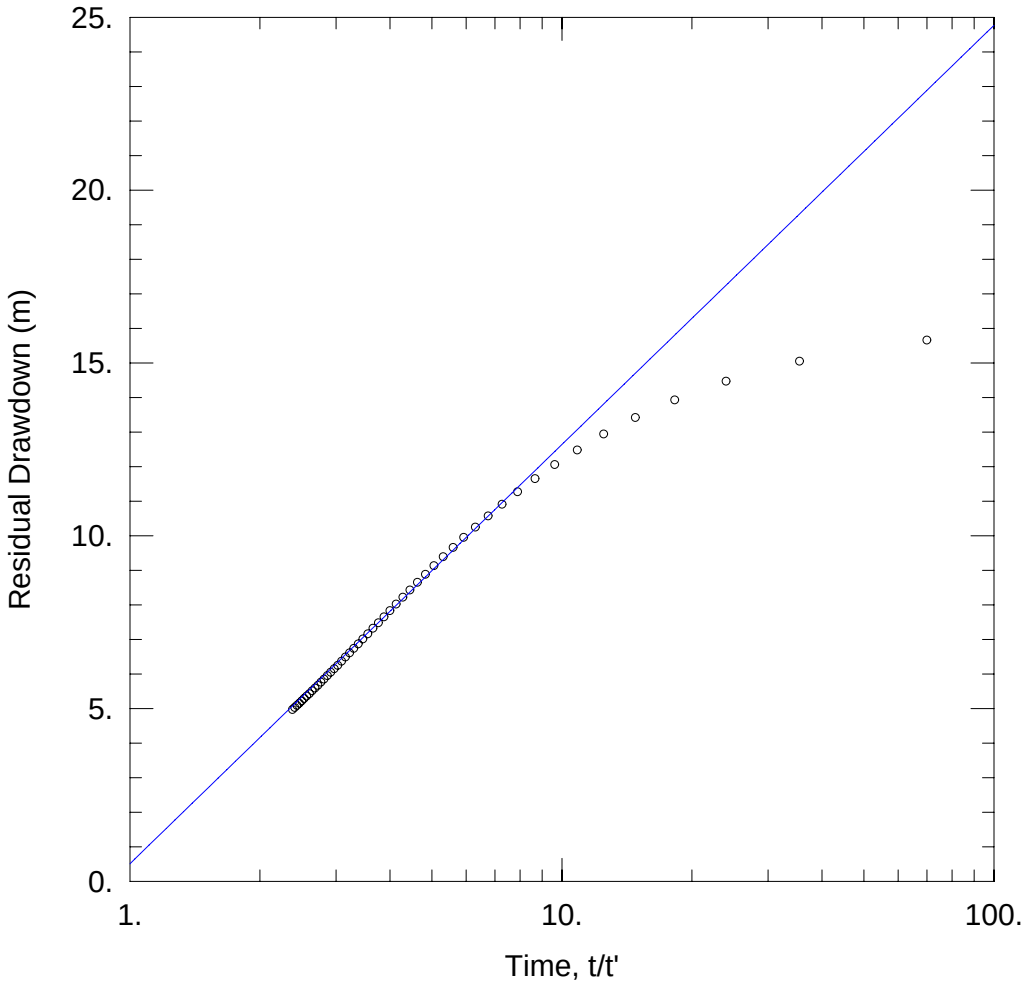
Observation Wells

Well Name	X (m)	Y (m)
◦ Signer Well	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 8.718E-5 m^2/min
S = 0.001559
Kz/Kr = 1.
b = 1.22 m



SIGNER WELL

Data Set: O:\hg\PROJECTS\2007-2008\Signer Well Complaint\Signer 02 Recovery Testl.aqt
Date: 12/13/07 Time: 12:01:23

PROJECT INFORMATION

Company: Alberta Research Council
Client: Alberta Environment
Project: 8789017
Location: SE-10-027-22 W4M
Test Well: Signer Well
Test Date: February 7, 2002

AQUIFER DATA

Saturated Thickness: 1.22 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
Signer	0	0

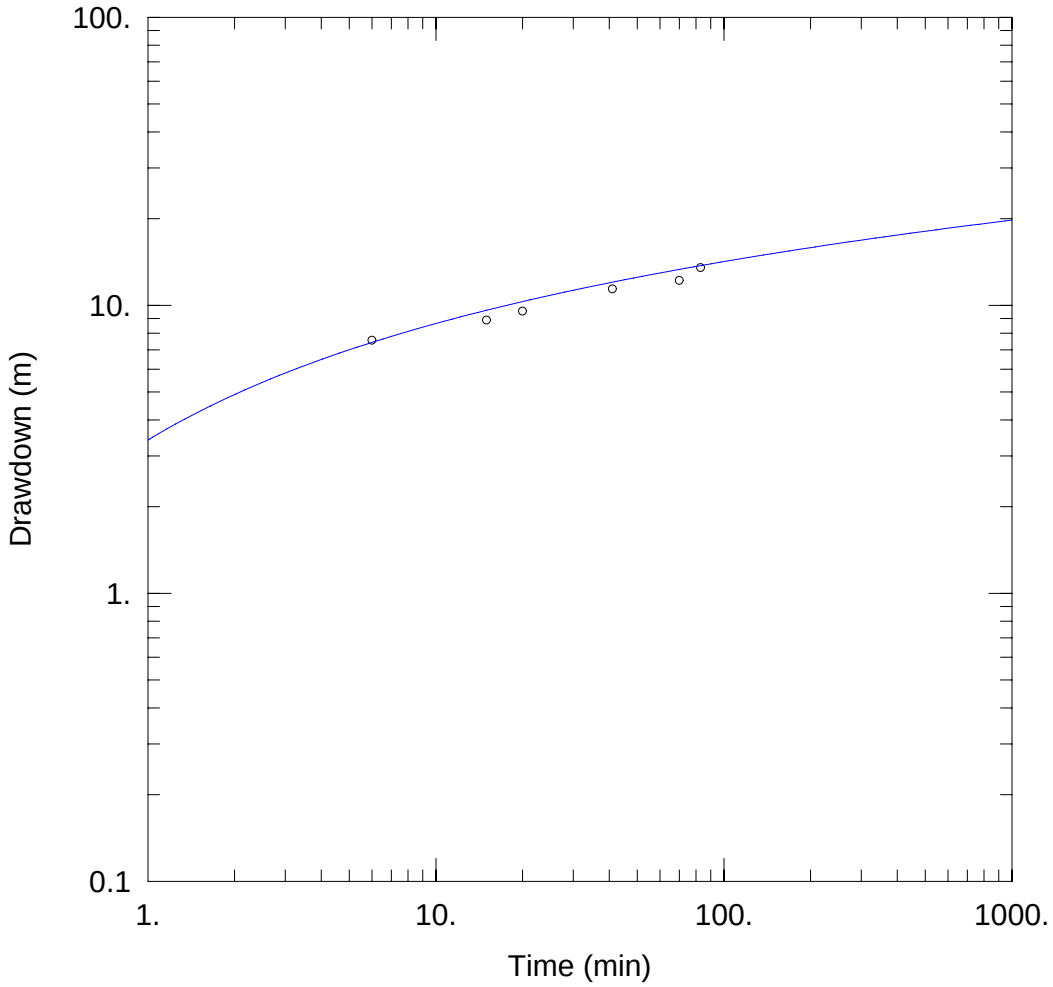
Observation Wells

Well Name	X (m)	Y (m)
◦ Signer Well	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.000114 m^2/min S/S' = 0.9081



SIGNER WELL

Data Set: O:\hg\PROJECTS\2007-2008\Signer Well Complaint\Aqtesolv\Signer 02 Pumping Test.aqt
Date: 12/13/07 Time: 13:30:20

PROJECT INFORMATION

Company: Alberta Research Council
Client: Alberta Environment
Project: 8789017
Location: SE-10-027-22 W4M
Test Well: Signer Well
Test Date: June 4, 2007

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
Signer	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ Signer Well	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 0.0001742 m^2/min
S = 0.0001119
Kz/Kr = 1.
b = 1.22 m

APPENDIX D

ASSESSMENT OF METHANE GAS MIGRATION POTENTIAL

Assessment of the forces controlling the methane gas bubble migration (personal communication with Dr. Jon Jones, PhD., University of Waterloo).

Buoyancy Force:

Buoyancy is the upward force exerted on an object produced by the surrounding fluid in which it is fully or partially immersed due to the pressure difference of the fluid between the top and the bottom of the object. Buoyancy is the force that gives the wings on airplanes the lift required for them to fly.

The net upward buoyancy force is equal to the magnitude of the weight of the fluid displaced by the object.

In simpler terms: Suppose you put a rubber ball in a beaker of water. One of three things will happen:

1) If the weight of the rubber ball equals the weight of the volume of water it displaces: the ball will remain stationary

2) If the weight of the ball is less than the weight of the volume of water it displaces: the ball will begin to float upwards until it breaks through the water surface and will continue to rise until the weight of the volume of water displaced equals the weight of the rubber ball. This is why ice bergs float. A cubic meter of iceberg weighs less than a cubic meter of ocean water.

3) If the weight of the ball is greater than the weight of the volume of water it displaces: the rubber ball will sink to the bottom of the beaker.

Weight Force (In Terms of Methane Gas and Water):

One cubic metre of methane gas under 1 atmosphere of pressure at 15° C has a mass of ~ 0.68 kg. One cubic metre of water under the same conditions has a mass of ~ 1000 kg. So if we placed a bubble of methane gas in our beaker, it would always float upwards because the mass of the methane is much less than the mass of the water it displaces.

Comparison of Forces:

Looking at the forces acting on the bubble of methane gas:

The net force pulling the methane gas bubble upwards is: Fb - Wm

Where Fb = Buoyant force [MLT-2]

Wm = Weight of the bubble [MLT-2]

We have established that the weight of the methane gas bubble is much less than the buoyant force (which is equal to the weight of the water that the bubble displaces). Therefore, the gas bubble will migrate upwards at some velocity.

If the velocity at which the methane gas bubble is rising were to be counteracted by water flowing downwards at the same velocity, then the bubble would remain stationary. If the water velocity were increased, the bubble would be pushed downward. Conversely, if the water velocity were decreased, the bubble would again begin to move upward, albeit at a slower rate.

The velocity at which a gas bubble migrates upward in a column of water is a function of the size of the bubble, i.e. the larger the bubble, the larger the upward velocity due to the increase in the net upward buoyant force. Also note that, as the gas bubble migrates upwards, it will be hindered by friction exerted on the bubble due to the viscosity of the fluid it is rising through.

Calculation Results:
Given the velocity that a gas bubble migrates upward in a column of water, it is simply a matter of determining if there is sufficient downward water velocity to counteract the upward migration of the bubble.

Radius of gas bubble (m)	Terminal upward velocity (m/s)
1.0×10^{-6}	2.18×10^{-6}
1.0×10^{-5}	2.18×10^{-4}
1.0×10^{-4}	2.18×10^{-2}
1.0×10^{-3}	2.18×10^{0}

Note: The upward velocities values listed represent theoretical maximum values. There are a number of factors that can affect these values.

The three most likely scenarios for the migration of the gas bubbles in natural systems would be through fractures, porous media and through cylindrical conduits like boreholes. The formulae for calculating the water velocities in these openings can be found in any standard hydrogeology textbook. Naturally, the site-specific conditions (and corresponding hydrological parameters) will dictate which particular formula (or formulae) is used.

Partial List of Mitigating Factors Affecting Upward Gas Migration

1. Tortuosity: Except for the case of upward migration through a borehole, the bubble will have to take a circuitous path in its upward migration as it manoeuvres through interconnected pore throats or fracture networks. As a result, the upward migration of the gas will be hindered.

2. Relative Size of the Gas Bubble to Pore Throat, Borehole or Fracture Aperture it is Flowing Through: If the diameter of the bubble is of the same order as the opening it is flowing through, there will be additional frictional forces slowing down the upward migration of the gas. The velocity values listed above assume that these forces are negligible.

3. Gas Entry Pressure: For the case of gas migration through fracture apertures or pore throats that are smaller than the diameter of the gas bubble, sufficient upward buoyant force is required for the bubble to exceed the gas entry pressure. All other factors being constant, a single gas bubble whose initial buoyant force is insufficient to overcome the gas entry pressure will remain trapped. However, the usual case is a large number of gas bubbles migrating simultaneously.

As the gas consolidates at entrapment sites, the buoyancy force will increase and eventually upward migration will resume.

4. Bubble Volume as a Function of Pressure: As the gas bubble migrates upward, the column of fluid exerting pressure on the bubble decreases. As a result, the bubble increases in size, thereby generating greater upward velocity due to an increase in the buoyant force. A quantitative expression relating the dynamics between bubble expansion and while moving upward and the accompanying increase in velocity are very difficult to obtain. For the velocities listed above, it was assumed that the size of the bubble remains constant. Whereas the first three mitigating factors in this list would tend to decrease the rate of upward gas migration, this factor would increase it.

5. Any geochemical processes that would make the bubble lose mass during migration (and thereby reduce its volume and decrease its upward velocity). However, it is very likely that this factor would be negligible in most instances.

APPENDIX E

CHEMICAL ANALYSES

Signer Domestic Water Well
Chemical Analysis (26 Nov 03)

WSH labs (1992) LTD.
3851B - 21 Street N.E.
Calgary, Alberta
Canada T2E6T5
Ph: (403) 250-9164
Fax: (403) 291-4597
Website: www.wshlabs.com

M & M Drilling Co. Ltd.	P.O # 3278	Client I.D	Deb Signer House Well
Box 1, Site 22, RR# 2	Lab # 41121	Legal	SE-10-27-22-W4
Strathmore, AB T1P 1K5	Ph 934-4271	Date Sampled	11/26/03
Attn Bill Murray	Fax 934-4865	Date Received	11/27/03
		Date Reported	12/4/03

WATER RESULTS

Cations	mg/L	Anions	mg/L	General Parameters	mg/L	
Saturation Index	0.1	Bicarbonates	812	E.C. (µS/cm)	1941	
Calcium	5.1	Bromides	< 0.6	Coliform, Total	TNTC	(CFU/100mL)
Iron	0.034	Carbonates	0	Escherichia Coli (E.Coli)	0	(CFU/100mL)
Magnesium	< 0.1	Chlorides	269	Heterotrophic Plate Count		(MPN/mL)
Manganese	< 0.01	Fluorides	1.5	Hardness ($CaCO_3$)	13	*SOFT*
Potassium	< 0.5	Nitrates	1.5	pH	8.15	
Silicon		Nitrites	< 0.3	Sulfides (S)	0.01	
Sodium	472	NO_3+NO_2	1.5	T. Alkalinity ($CaCO_3$)	666	
Ammonium	< 0.1	Phosphates	N/A	T.D.S (Calculated)	1149	
		Sulfates	< 0.6	Turbidity (N.T.U)	1.60	
Sum of Cations	20.78			Total Organic Carbon	10.5	
Sum of Anions	21.00			Total Kjeldahl Nitrogen		
Ionic Balance	0.99			Ammonia Nitrogen		
% Difference	-0.53			Total Phosphorus		
T.D.S. / E.C. Ratio	0.59			Color (T.C.U)		
SAR	56.52	*(May limit plant growth)*				

Trace Metals Profile

	ug/L		ug/L		ug/L
Phosphorus	77	Cadmium	< 0.8	Barium	107
Thallium	< 5	Nickel	< 2	Lithium	120
Arsenic	< 2	Beryllium	< 0.8	Tin	1
Selenium	5	Thorium	< 5	Molybdenum	2
Chromium	< 0.8	Vanadium	< 0.8	Antimony	< 1
Zinc	3	Bismuth	< 2	Titanium	< 1
Lead	< 2	Silver	< 0.8	Zirconium	< 1
Copper	1	Aluminum	4	Uranium	
Cobalt	< 0.8	Strontium	74	Mercury	

Silty samples may account for higher iron, manganese and silicon content.
*TDS: Total Dissolved Solids *SAR : Sodium Adsorption Ratio
*TNTC: Too Numerous To Count *< Denotes less than detection limit
The results above are related only to the items analyzed.
Please see the reverse side of this page for the Canadian Drinking Water Quality Guideline

Certified By

Signer Domestic Water Well
Chemical Analysis (12 Aug 04)

WSHLabs (1992) LTD.
3851B - 21 Street N.E.
Calgary, Alberta
Canada T2E6T5
Ph: (403) 250-9164
Fax: (403) 291-4597
Website: www.wshlabs.com

M & M Drilling Co. Ltd.
Box 1, Site 22, RR 2
Strathmore, AB T1P 1K5

Phone: 934-4271
Fax: 934-4865
Cell:

Lab Number: 44210
PO Number: 4121

Attention:	Bill Murray	**Date Sampled:**	8/13/2004
Client ID:	Debbie Singer	**Date Received:**	8/13/2004
Location:		**Date Reported:**	8/17/2004
Legal:	SE-10-27-22-W4		

Cations

	mg/L
Calcium	8.5
Iron	0.060
Magnesium	1.0
Manganese	<0.01
Potassium	2.3
Sodium	465
Ammonium	<0.1

Anions

	mg/L
Bicarbonates	807
Bromides	<0.6
Carbonates	0
Chlorides	232
Fluorides	1.43
Nitrates	<0.2
Nitrites	<0.3
$NO_3 + NO_2$	<0.2
Sulfates	<0.6

Sum of Cations	20.78
Sum of Anions	19.85
Ion Balance	1.05
% Difference	2.31
TDS / EC Ratio	0.57
SAR	40.16
Saturation Index	0.3

General Parameters

Electrical Conductivity (µS/cm)	1946
pH (in pH units)	8.12
Hardness (as mg/L $CaCO_3$)	25
Total Alkalinity (as mg/L $CaCO_3$)	662
Calculated TDS (mg/L)	1107

Other Parameters

Total Coliform (CFU/100mL)	TNTC
Escherichia Coliform (CFU/100mL)	0
Heterotrophic Plate Count (MPN/mL)	
Sulfides (S) (mg/L)	0.020
Turbidity (NTU)	1.2
Color (TCU)	
Total Kjeldahl Nitrogen (mg/L)	
Ammonia Nitrogen (mg/L)	
Organic Nitrogen (mg/L)	
Total Phosphorus (mg/L)	
Total Organic Carbon (mg/L)	10.6
Dissolved Organic Carbon (mg/L)	
Trihalomethanes (mg/L)	
Boron (mg/L)	
Silicon (mg/L)	
Phenol (mg/L)	
Cyanide (mg/L)	
Total Suspended Solids (mg/L)	
Total Dissolved Solids (mg/L)	

BACTERIA DETECTED
RECOMMEND SHOCK CHLORINATION

Trace Metals

	µg/L
Thallium	<5
Thorium	<5
Tin	1
Molybdenum	3
Antimony	4
Titanium	<1
Zirconium	2
Phosphorus	106
Arsenic	4
Selenium	<2
Lead	<2
Bismuth	<2
Nickel	<2
Aluminum	12
Chromium	<0.8
Zinc	17
Copper	1
Cadmium	<0.8
Beryllium	<0.8
Cobalt	3
Vanadium	1
Silver	<0.8
Strontium	60
Barium	87
Lithium	92
Uranium	
Mercury	

Certified By:

Silty samples may account for higher iron, manganese and silicon concentrations.
The results above are related only to the items analyzed.
Please see the reverse side of this page for the Canadian Drinking Water Quality Guideline.
TDS = Total Dissolved Solids, SAR = Sodium Adsorption Ratio, TNTC = Too Numerous To Count (>200 colonies), < denotes less than detection limit
Analysis methods are based on Standard Methods for the Examination of Water and Wastewater 20th Edition and can be made available upon request.

NORWEST LABS

Signer Domestic Water Well
Chemical Analysis (22 Sep 04)
Analytical Report

Norwest Labs
7217 Roper Road
Edmonton, AB. T6B 3J4
Phone: (780) 438-5522
Fax: (780) 438-0396

Bill to: Hydrogeological Consultants
Report to: Hydrogeological Consultants
10704 - 181 Street
Edmonton, AB, Canada
T5S1K8
Attn: Mike Semple
Sampled By: MS
Company: HCL

Project
ID: 04-512
Name: D. Signer Dom. W.W.
Location: Redland
LSD:
P.O.: 2371
Acct. Code:

NWL Lot ID: 334160
Control Number: E 207456
Date Received: Sep 22, 2004
Date Reported: Sep 24, 2004
Report Number: 598426

NWL Number	334160-1
Sample Description	D. Signer - Hose bib.
Sample Matrix	Water - Potable

Analyte		Units	Result	Detection Limit	Guideline Limit	Guideline Comments
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1	1	<1	Pass
Fecal Coliforms	Membrane Filtration	CFU/100 mL	<1	1	<1	Pass
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Acceptable
Turbidity		NTU	0.9	0.1	5	Acceptable
Temp. of observed pH and EC		°C	19.7	-		n/a
Routine Water						
pH			8.38	-	6.5 - 8.5	Acceptable
Electrical Conductivity		µS/cm at 25 C	1890	1		n/a
Calcium	Extractable	mg/L	4.2	0.2		n/a
Magnesium	Extractable	mg/L	0.3	0.1		n/a
Sodium	Extractable	mg/L	437	0.4	200	Above Aesthetic
Potassium	Extractable	mg/L	1.2	0.4		n/a
Iron	Extractable	mg/L	0.01	0.01	0.3	Acceptable
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Acceptable
Chloride	Dissolved	mg/L	212	0.5	250	Acceptable
Fluoride		mg/L	1.26	0.05	1.5	Pass
Nitrate - N		mg/L	<0.1	0.1	10	Pass
Nitrite - N		mg/L	<0.05	0.05	1	Pass
Nitrate and Nitrite - N		mg/L	<0.2	0.2	10	Pass
Sulphate (SO4)		mg/L	0.45	0.2	500	Acceptable
Hydroxide		mg/L	<5	5		n/a
Carbonate		mg/L	7	6		n/a
Bicarbonate		mg/L	831	5		n/a
P-Alkalinity	as CaCO3	mg/L	6	5		n/a
T-Alkalinity	as CaCO3	mg/L	694	5		Highly Alkaline
Total dissolved solids		mg/L	1070	1	500	Above Aesthetic
Hardness	as CaCO3	mg/L	11.6	-		Soft
Ionic Balance		%	97	-		n/a

NORWEST LABS

Signer Domestic Water Well
Chemical Analysis (30 Sep 04)
Analytical Report

Norwest Labs
Bay 9, 2712-37 Avenue N.E.
Calgary, AB. T1Y-5L3
Phone: (403) 291-2022
Fax: (403) 291-2021

Bill to: Hydrogeological Consultants
Report to: Hydrogeological Consultants
10704 - 181 Street
Edmonton, AB, Canada
T5S1K8
Attn: Mike Semple
Sampled By: Mike Semple
Company: HCL

Project
ID: 04-512
Name: D. Signer Dom WW
Location:
LSD:
P.O.: 2386
Acct. Code:

NWL Lot ID: **336130**
Control Number: E 183535
Date Received: Sep 30, 2004
Date Reported: Oct 05, 2004
Report Number: 602292

NWL Number	336130-1
Sample Date	Sep 30, 2004
Sample Description	D. Signer Dom WW / Sept 30/04
Sample Matrix	Water - Potable

Analyte		Units	Result	Detection Limit	Guideline Limit	Guideline Comments
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1	1	<1	Pass
Escherichia coli	Membrane Filtration	CFU/100 mL	<1	1	<1	Pass
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	5	5	15	Acceptable
Turbidity		NTU	6.8	0.1	5	Above Asethetic
Temp. of observed pH and EC		°C	20.1	-		n/a
Routine Water						
pH			8.42	-	6.5 - 8.5	Acceptable
Electrical Conductivity		µS/cm at 25 C	1930	1		n/a
Calcium	Extractable	mg/L	3.8	0.2		n/a
Magnesium	Extractable	mg/L	0.3	0.1		n/a
Sodium	Extractable	mg/L	440	0.4	200	Above Aesthetic
Potassium	Extractable	mg/L	0.9	0.4		n/a
Iron	Extractable	mg/L	<0.01	0.01	0.3	Acceptable
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Acceptable
Chloride	Dissolved	mg/L	224	0.5	250	Acceptable
Fluoride		mg/L	1.30	0.05	1.5	Pass
Nitrate - N		mg/L	<0.1	0.1	10	Pass
Nitrite - N		mg/L	<0.05	0.05	1	Pass
Nitrate and Nitrite - N		mg/L	<0.2	0.2	10	Pass
Sulphate (SO4)		mg/L	0.60	0.2	500	Acceptable
Hydroxide		mg/L	<5	5		n/a
Carbonate		mg/L	12	6		n/a
Bicarbonate		mg/L	820	5		n/a
P-Alkalinity	as CaCO3	mg/L	10	5		n/a
T-Alkalinity	as CaCO3	mg/L	693	5		Highly Alkaline
Total dissolved solids		mg/L	1090	1	500	Above Aesthetic
Hardness	as CaCO3	mg/L	11	-		Soft
Ionic Balance		%	96	-		n/a

Please Note: Related regulatory criteria are provided as a service to clients. Norwest Labs' responsibility is limited to analytical data. We are not responsible for ensuring that listed criteria are current, scientifically valid, appropriate and sufficient for the user of the data.

Signer Domestic Water Well
Bacterial Activity Reaction Test Results (BART)
(Sampled on 22 Sep 04 and 30 Sep 04)

Samples collected on: 22-Sep-04

		Days Since Groundwater Sample Collected									
Sample/Source	BART Test	1 23 Sep 04	2 24 Sep 04	3 25 Sep 04	4 26 Sep 04	5 27 Sep 04	6 28 Sep 04	7 29 Sep 04	8 30 Sep 04	9 01 Oct 04	10 02 Oct 04
Singer Dom. WW / cistern	IRB	-	-	-	+	+	+	+	+	+	+
	SRB	-	+	+	+	+	+	+	+	+	+
	SLYM	-	+	+	+	+	+	+	+	+	+

\+ Positive Reaction - Negative Reaction

IRB - Iron-Related Bacteria SRB - Sulfate-Reducing Bacteria SLYM - Slime-Forming Bacteria

Aggressivity of Bacteria: high medium low

Notes: IRB - Foam around ball on day 4
SRB - Black at base on day 2
SLYM - Cloudy on day 2

Samples collected on: 30-Sep-04

		Days Since Groundwater Sample Collected									
Sample/Source	BART Test	1 01 Oct 04	2 02 Oct 04	3 03 Oct 04	4 04 Oct 04	5 05 Oct 04	6 06 Oct 04	7 07 Oct 04	8 08 Oct 04	9 09 Oct 04	10 10 Oct 04
Singer Dom WW (bailed from WW)	IRB	-	+	+	+	+	+	+	+	+	+
	SRB	-	+	+	+	+	+	+	+	+	+
	SLYM	-	-	+	+	+	+	+	+	+	+

\+ Positive Reaction - Negative Reaction

IRB - Iron-Related Bacteria SRB - Sulfate-Reducing Bacteria SLYM - Slime-Forming Bacteria

Aggressivity of Bacteria: high medium low

Notes: IRB - Foam around ball on day 2
SRB - Black at base on day 2
SLYM - Cloudy on day 3

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L389137-1 SIGNER CISTERN								
Sample By: LESLIE on 16-MAY-06 @ 12:30								
Matrix: WATER								
Iron Reducing Bacteria	<10		10	CFU/mL		17-MAY-06	BC	R406887
Sulphate Reducing Bacteria	<0.3		0.3	MPN/mL		17-MAY-06	BC	R406887
Total & Fecal Coliforms								
Total Coliforms	<1		1	CFU/100mL		17-MAY-06	BC	R401817
Fecal Coliforms	<1		1	CFU/100mL		17-MAY-06	BC	R401817
L389137-2 SIGNER RESIDENCE								
Sample By: LESLIE on 16-MAY-06 @ 12:30								
Matrix: WATER								
Dissolved Metals								
Dissolved Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		19-MAY-06	QLI	R401300
Aluminum (Al)	<0.01		0.01	mg/L		19-MAY-06	QLI	R401300
Boron (B)	0.29		0.05	mg/L		19-MAY-06	QLI	R401300
Barium (Ba)	0.123		0.003	mg/L		19-MAY-06	QLI	R401300
Beryllium (Be)	<0.001		0.001	mg/L		19-MAY-06	QLI	R401300
Cadmium (Cd)	<0.001		0.001	mg/L		19-MAY-06	QLI	R401300
Cobalt (Co)	<0.002		0.002	mg/L		19-MAY-06	QLI	R401300
Chromium (Cr)	0.006		0.005	mg/L		19-MAY-06	QLI	R401300
Copper (Cu)	<0.001		0.001	mg/L		19-MAY-06	QLI	R401300
Molybdenum (Mo)	<0.005		0.005	mg/L		19-MAY-06	QLI	R401300
Nickel (Ni)	<0.002		0.002	mg/L		19-MAY-06	QLI	R401300
Lead (Pb)	<0.005		0.005	mg/L		19-MAY-06	QLI	R401300
Tin (Sn)	<0.05		0.05	mg/L		19-MAY-06	QLI	R401300
Strontium (Sr)	0.086		0.005	mg/L		19-MAY-06	QLI	R401300
Titanium (Ti)	0.001		0.001	mg/L		19-MAY-06	QLI	R401300
Thallium (Tl)	<0.05		0.05	mg/L		19-MAY-06	QLI	R401300
Vanadium (V)	0.006		0.001	mg/L		19-MAY-06	QLI	R401300
Zinc (Zn)	0.005		0.001	mg/L		19-MAY-06	QLI	R401300
Dissolved Major Metals								
Calcium (Ca)	4.2		0.5	mg/L		18-MAY-06	SYF	R400325
Potassium (K)	1.1		0.1	mg/L		18-MAY-06	SYF	R400325
Magnesium (Mg)	0.36		0.01	mg/L		18-MAY-06	SYF	R400325
Sodium (Na)	409		0.5	mg/L		18-MAY-06	SYF	R400325
Iron (Fe)	0.039		0.005	mg/L		18-MAY-06	SYF	R400325
Manganese (Mn)	0.003		0.001	mg/L		18-MAY-06	SYF	R400325
Methane, Ethane and Ethene; Dissolved								
Methane, Dissolved	27	EHT	0.005	mg/L		23-MAY-06	NOS	R401520
Ethane, Dissolved	<0.005	EHT	0.005	mg/L		23-MAY-06	NOS	R401520
Ethene, Dissolved	<0.005	EHT	0.005	mg/L		23-MAY-06	NOS	R401520
Iron Reducing Bacteria	<10		10	CFU/mL		17-MAY-06	BC	R406887
Sulphate Reducing Bacteria	<0.3		0.3	MPN/mL		17-MAY-06	BC	R406887
Total & Fecal Coliforms								
Total Coliforms	<1		1	CFU/100mL		17-MAY-06	BC	R401817
Fecal Coliforms	<1		1	CFU/100mL		17-MAY-06	BC	R401817
BTEX								
Benzene	<0.0005		0.0005	mg/L	18-MAY-06	18-MAY-06	KEB	R400632
Toluene	<0.0005		0.0005	mg/L	18-MAY-06	18-MAY-06	KEB	R400632
Ethylbenzene	<0.0005		0.0005	mg/L	18-MAY-06	18-MAY-06	KEB	R400632
Xylenes	<0.0005		0.0005	mg/L	18-MAY-06	18-MAY-06	KEB	R400632
Routine Water: Major Ions, Fe & Mn								

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L389137-2 SIGNER RESIDENCE								
Sample By: LESLIE on 16-MAY-06 @ 12:30								
Matrix: WATER								
Routine Water: Major Ions, Fe & Mn								
Iron (Fe)-Extractable	0.10		0.06	mg/L		18-MAY-06	RAZ	R399708
Manganese(Mn)-Extractable	<0.02		0.02	mg/L		18-MAY-06	RAZ	R399708
Chloride (Cl)	239		0.1	mg/L		18-MAY-06	LHH	R400128
Nitrate+Nitrite-N	<0.05		0.05	mg/L		18-MAY-06	LHH	R400128
Nitrate-N	<0.05		0.05	mg/L		18-MAY-06	LHH	R400128
Nitrite-N	<0.05		0.05	mg/L		18-MAY-06	LHH	R400128
Sulphate (SO4)	<0.5		0.5	mg/L		18-MAY-06	LHH	R400128
pH, Conductivity and Total Alkalinity								
pH	8.4		0.1	pH		17-MAY-06	LPW	R400078
Conductivity (EC)	1910		3	uS/cm		17-MAY-06	LPW	R400078
Bicarbonate (HCO3)	809		5	mg/L		17-MAY-06	LPW	R400078
Carbonate (CO3)	12		5	mg/L		17-MAY-06	LPW	R400078
Hydroxide (OH)	<5		5	mg/L		17-MAY-06	LPW	R400078
Alkalinity, Total (as CaCO3)	683		5	mg/L		17-MAY-06	LPW	R400078
Ion Balance Calculation								
Ion Balance	93.8			%		19-MAY-06		
TDS (Calculated)	1090			mg/L		19-MAY-06		
Hardness (as CaCO3)	11			mg/L		19-MAY-06		
ICP metals for routine water								
Calcium (Ca)	3.9		0.5	mg/L		18-MAY-06	RAZ	R399708
Potassium (K)	1.1		0.1	mg/L		18-MAY-06	RAZ	R399708
Magnesium (Mg)	0.4		0.1	mg/L		18-MAY-06	RAZ	R399708
Sodium (Na)	434		1	mg/L		18-MAY-06	RAZ	R399708
L389137-3 SIGNER SLUDGE								
Sample By: LESLIE on 16-MAY-06 @ 12:30								
Matrix: WATER								
Bacteria Identification by Ribotyping	See attachment.				25-MAY-06	26-MAY-06	THT	R403945
Note: Gram-negative bacteria. Isolate #1: Aeromonas hydrophila Isolate #2: Aeromonas hydrophila								
Special Request	See Below					25-MAY-06	BTV	R404270
	Additional Text: Gram negative.Possible organism Aeromonas hydrophilia group 1.							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L399881-1 (1) SIGNER WELL								
Sampled By: LM on 14-JUN-06 @ 11:00								
Matrix: WATER								
Dissolved Metals								
Dissolved Major Metals								
Iron (Fe)	0.239		0.005	mg/L		15-JUN-06	HAS	R409904
Manganese (Mn)	0.013		0.001	mg/L		15-JUN-06	HAS	R409904
Dissolved Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Aluminum (Al)	0.09		0.01	mg/L		15-JUN-06	QLI	R409998
Boron (B)	0.30		0.05	mg/L		15-JUN-06	QLI	R409998
Barium (Ba)	0.122		0.003	mg/L		15-JUN-06	QLI	R409998
Beryllium (Be)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Cadmium (Cd)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Cobalt (Co)	<0.002		0.002	mg/L		15-JUN-06	QLI	R409998
Chromium (Cr)	0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Copper (Cu)	0.014		0.001	mg/L		15-JUN-06	QLI	R409998
Molybdenum (Mo)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Nickel (Ni)	<0.002		0.002	mg/L		15-JUN-06	QLI	R409998
Lead (Pb)	0.135		0.005	mg/L		15-JUN-06	QLI	R409998
Tin (Sn)	<0.05		0.05	mg/L		15-JUN-06	QLI	R409998
Strontium (Sr)	0.090		0.005	mg/L		15-JUN-06	QLI	R409998
Titanium (Ti)	0.003		0.001	mg/L		15-JUN-06	QLI	R409998
Thallium (Tl)	<0.05		0.05	mg/L		15-JUN-06	QLI	R409998
Vanadium (V)	0.003		0.001	mg/L		15-JUN-06	QLI	R409998
Zinc (Zn)	0.231		0.001	mg/L		15-JUN-06	QLI	R409998
Free CO2	<1		1	mg/L		14-JUN-06	GCM	R409646
Heterotrophic Plate Count	30000		1	CFU/mL		14-JUN-06	BC	R412484
Iron Reducing Bacteria	<10		10	CFU/mL		14-JUN-06	BC	R416521
Aeromonas hydrophila	18		1	CFU/mL		14-JUN-06	BC	R412485
Sulphate Reducing Bacteria	<0.3		0.3	MPN/mL		14-JUN-06	BC	R416521
Total & Fecal Coliforms								
Total Coliforms	CGWC		1	CFU/100mL		14-JUN-06	BC	R409876
Fecal Coliforms	2		1	CFU/100mL		14-JUN-06	BC	R409876
Note: CGWC: Confluent Growth with Coliforms								
Routine Water: Major Ions, Fe & Mn								
Chloride (Cl)	232		0.1	mg/L		14-JUN-06	LHH	R409286
ICP metals for routine water								
Calcium (Ca)	6.0		0.5	mg/L		15-JUN-06	RAZ	R409515
Potassium (K)	1.1		0.1	mg/L		15-JUN-06	RAZ	R409515
Magnesium (Mg)	0.5		0.1	mg/L		15-JUN-06	RAZ	R409515
Sodium (Na)	481		1	mg/L		15-JUN-06	RAZ	R409515
Ion Balance Calculation								
Ion Balance	107			%		15-JUN-06		
TDS (Calculated)	1120			mg/L		15-JUN-06		
Hardness (as CaCO3)	17			mg/L		15-JUN-06		
Iron (Fe)-Extractable	<0.06		0.06	mg/L		15-JUN-06	RAZ	R409515
Manganese(Mn)-Extractable	<0.02		0.02	mg/L		15-JUN-06	RAZ	R409515
Nitrate+Nitrite-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Nitrate-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Nitrite-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Sulphate (SO4)	<0.5		0.5	mg/L		14-JUN-06	LHH	R409286
pH, Conductivity and Total Alkalinity								
pH	8.5		0.1	pH		15-JUN-06	JF	R409243
Conductivity (EC)	1890		3	uS/cm		15-JUN-06	JF	R409243

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L399881-1 (1) SIGNER WELL								
Sampled By: LM on 14-JUN-06 @ 11:00								
Matrix: WATER								
Routine Water: Major Ions, Fe & Mn								
pH, Conductivity and Total Alkalinity								
Bicarbonate (HCO3)	780		5	mg/L		15-JUN-06	JF	R409243
Carbonate (CO3)	17		5	mg/L		15-JUN-06	JF	R409243
Hydroxide (OH)	<5		5	mg/L		15-JUN-06	JF	R409243
Alkalinity, Total (as CaCO3)	667		5	mg/L		15-JUN-06	JF	R409243
L399881-2 (2) SIGNER CISTERN								
Sampled By: LM on 14-JUN-06 @ 11:30								
Matrix: WATER								
Dissolved Metals								
Dissolved Major Metals								
Iron (Fe)	0.023		0.005	mg/L		15-JUN-06	HAS	R409904
Manganese (Mn)	0.003		0.001	mg/L		15-JUN-06	HAS	R409904
Dissolved Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Aluminum (Al)	<0.01		0.01	mg/L		15-JUN-06	QLI	R409998
Boron (B)	0.32		0.05	mg/L		15-JUN-06	QLI	R409998
Barium (Ba)	0.116		0.003	mg/L		15-JUN-06	QLI	R409998
Beryllium (Be)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Cadmium (Cd)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Cobalt (Co)	<0.002		0.002	mg/L		15-JUN-06	QLI	R409998
Chromium (Cr)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Copper (Cu)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Molybdenum (Mo)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Nickel (Ni)	<0.002		0.002	mg/L		15-JUN-06	QLI	R409998
Lead (Pb)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Tin (Sn)	<0.05		0.05	mg/L		15-JUN-06	QLI	R409998
Strontium (Sr)	0.091		0.005	mg/L		15-JUN-06	QLI	R409998
Titanium (Ti)	0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Thallium (Tl)	<0.05		0.05	mg/L		15-JUN-06	QLI	R409998
Vanadium (V)	0.003		0.001	mg/L		15-JUN-06	QLI	R409998
Zinc (Zn)	0.004		0.001	mg/L		15-JUN-06	QLI	R409998
Free CO2	<1		1	mg/L		14-JUN-06	GCM	R409646
Heterotrophic Plate Count	22000		1	CFU/mL		14-JUN-06	BC	R412484
Iron Reducing Bacteria	250		10	CFU/mL		14-JUN-06	BC	R416521
Aeromonas hydrophila	26		1	CFU/mL		14-JUN-06	BC	R412485
Sulphate Reducing Bacteria	<0.3		0.3	MPN/mL		14-JUN-06	BC	R416521
Total & Fecal Coliforms								
Total Coliforms	<1		1	CFU/100mL		14-JUN-06	BC	R409876
Fecal Coliforms	<1		1	CFU/100mL		14-JUN-06	BC	R409876
Routine Water: Major Ions, Fe & Mn								
Chloride (Cl)	220		0.1	mg/L		14-JUN-06	LHH	R409286
ICP metals for routine water								
Calcium (Ca)	3.6		0.5	mg/L		15-JUN-06	RAZ	R409515
Potassium (K)	1.2		0.1	mg/L		15-JUN-06	RAZ	R409515
Magnesium (Mg)	0.4		0.1	mg/L		15-JUN-06	RAZ	R409515
Sodium (Na)	491		1	mg/L		15-JUN-06	RAZ	R409515
Ion Balance Calculation								
Ion Balance	108			%		15-JUN-06		
TDS (Calculated)	1130			mg/L		15-JUN-06		
Hardness (as CaCO3)	11			mg/L		15-JUN-06		
Iron (Fe)-Extractable	<0.06		0.06	mg/L		15-JUN-06	RAZ	R409515

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L399881-2 (2) SIGNER CISTERN								
Sampled By: LM on 14-JUN-06 @ 11:30								
Matrix: WATER								
Routine Water: Major Ions, Fe & Mn								
Manganese(Mn)-Extractable	<0.02		0.02	mg/L		15-JUN-06	RAZ	R409515
Nitrate+Nitrite-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Nitrate-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Nitrite-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Sulphate (SO4)	<0.5		0.5	mg/L		14-JUN-06	LHH	R409286
pH, Conductivity and Total Alkalinity								
pH	8.5		0.1	pH		15-JUN-06	JF	R409243
Conductivity (EC)	1900		3	uS/cm		15-JUN-06	JF	R409243
Bicarbonate (HCO3)	801		5	mg/L		15-JUN-06	JF	R409243
Carbonate (CO3)	20		5	mg/L		15-JUN-06	JF	R409243
Hydroxide (OH)	<5		5	mg/L		15-JUN-06	JF	R409243
Alkalinity, Total (as CaCO3)	691		5	mg/L		15-JUN-06	JF	R409243
L399881-3 (3) SIGNER KITCHEN TAP (COLD)								
Sampled By: LM on 14-JUN-06 @ 11:45								
Matrix: WATER								
Dissolved Metals								
Dissolved Major Metals								
Iron (Fe)	0.033		0.005	mg/L		15-JUN-06	HAS	R409904
Manganese (Mn)	0.007		0.001	mg/L		15-JUN-06	HAS	R409904
Dissolved Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Aluminum (Al)	0.02		0.01	mg/L		15-JUN-06	QLI	R409998
Boron (B)	0.32		0.05	mg/L		15-JUN-06	QLI	R409998
Barium (Ba)	0.115		0.003	mg/L		15-JUN-06	QLI	R409998
Beryllium (Be)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Cadmium (Cd)	<0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Cobalt (Co)	<0.002		0.002	mg/L		15-JUN-06	QLI	R409998
Chromium (Cr)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Copper (Cu)	0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Molybdenum (Mo)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Nickel (Ni)	<0.002		0.002	mg/L		15-JUN-06	QLI	R409998
Lead (Pb)	<0.005		0.005	mg/L		15-JUN-06	QLI	R409998
Tin (Sn)	<0.05		0.05	mg/L		15-JUN-06	QLI	R409998
Strontium (Sr)	0.092		0.005	mg/L		15-JUN-06	QLI	R409998
Titanium (Ti)	0.001		0.001	mg/L		15-JUN-06	QLI	R409998
Thallium (Tl)	<0.05		0.05	mg/L		15-JUN-06	QLI	R409998
Vanadium (V)	0.004		0.001	mg/L		15-JUN-06	QLI	R409998
Zinc (Zn)	0.018		0.001	mg/L		15-JUN-06	QLI	R409998
Free CO2	<1		1	mg/L		14-JUN-06	GCM	R409646
Heterotrophic Plate Count	16000		1	CFU/mL		14-JUN-06	BC	R412484
Iron Reducing Bacteria	90		10	CFU/mL		14-JUN-06	BC	R416521
Aeromonas hydrophila	46		1	CFU/mL		14-JUN-06	BC	R412485
Sulphate Reducing Bacteria	<0.3		0.3	MPN/mL		14-JUN-06	BC	R416521
Total & Fecal Coliforms								
Total Coliforms	<1		1	CFU/100mL		14-JUN-06	BC	R409876
Fecal Coliforms	<1		1	CFU/100mL		14-JUN-06	BC	R409876
Routine Water: Major Ions, Fe & Mn								
Chloride (Cl)	221		0.1	mg/L		14-JUN-06	LHH	R409286
ICP metals for routine water								
Calcium (Ca)	3.7		0.5	mg/L		15-JUN-06	RAZ	R409515

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L399881-3 (3) SIGNER KITCHEN TAP (COLD)								
Sampled By: LM on 14-JUN-06 @ 11:45								
Matrix: WATER								
Routine Water: Major Ions, Fe & Mn								
ICP metals for routine water								
Potassium (K)	1.2		0.1	mg/L		15-JUN-06	RAZ	R409515
Magnesium (Mg)	1.2		0.1	mg/L		15-JUN-06	RAZ	R409515
Sodium (Na)	451		1	mg/L		15-JUN-06	RAZ	R409515
Ion Balance Calculation								
Ion Balance	99.2			%		15-JUN-06		
TDS (Calculated)	1090			mg/L		15-JUN-06		
Hardness (as CaCO3)	14			mg/L		15-JUN-06		
Iron (Fe)-Extractable	0.12		0.06	mg/L		15-JUN-06	RAZ	R409515
Manganese(Mn)-Extractable	<0.02		0.02	mg/L		15-JUN-06	RAZ	R409515
Nitrate+Nitrite-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Nitrate-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Nitrite-N	<0.05		0.05	mg/L		14-JUN-06	LHH	R409286
Sulphate (SO4)	<0.5		0.5	mg/L		14-JUN-06	LHH	R409286
pH, Conductivity and Total Alkalinity								
pH	8.5		0.1	pH		15-JUN-06	JF	R409243
Conductivity (EC)	1910		3	uS/cm		15-JUN-06	JF	R409243
Bicarbonate (HCO3)	805		5	mg/L		15-JUN-06	JF	R409243
Carbonate (CO3)	20		5	mg/L		15-JUN-06	JF	R409243
Hydroxide (OH)	<5		5	mg/L		15-JUN-06	JF	R409243
Alkalinity, Total (as CaCO3)	694		5	mg/L		15-JUN-06	JF	R409243

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

HydroQual Laboratories Ltd.

#3, 6125 12th Street SE Calgary, Alberta Canada T2H 2K1
Tel (403) 253-7121 Fax (403) 252-9363 www.hydroqual.ca

Test Report

Client:	MIS202	Reference:	06-1160

Client

Client: Alberta Environment
Address: 2938 11St NE
City: Calgary
Country: Canada
Tel: 403-297-5913
Contact: Kevin Pilger

Operation: NA
Prov./State: Alberta
Postal/ZIP Code: T2E 7L7
Fax: 403-297-8232
Billing: NA

Sample

collected: 2006/06/14 at: Not Given by: K. Pilger
shipped: 2006/06/14 by: Client
received: 2006/06/14 at: 1400 by: L. Lamontaine
signed-in: 2006/06/14 at: 1435 by: B. MacDonald
container: Glass jars
seals: No initials: No frozen: No
storage: 25 ± 2oC

Samples are disposed following Supporting Work Instruction 4.3.1.4.3

sample	-1	-2	-3
client	1	2	3
sample type	Water	Water	Water
volume (m^3)	NA	NA	NA
description	Well	Cistern 1	Cistern 2

Test Log

test	Misc	Misc	Misc
started	2006/06/14	2006/06/14	2006/06/14
by	B.Macdonald	B.Macdonald	B.Macdonald
ended	2006/07/07	2006/07/07	2006/07/07
reported	2006/07/07	2006/07/07	2006/07/07
fax/e-mailed	2006/07/07	2006/07/07	2006/07/07

Comments: Regular turnaround. Bacterial identification.
Organisms observed: bacteria, amoebae, flagellates, ciliates, possible water fleas.
All bacteria were common to all samples. Escherichia was identified to species via IDEXX.

note: na, not applicable; BG, bulk identification to genus; BGE, BG with enumeration; TG, tape identification to genus; RG, RCS identification to genus; RS, RCS identification to species; RC, RCS classification of organisms; AOC, Air-o-Cell spore trap analysis; SG, swab identification to genus; SS, swab identification to species; SGE, SG with enumeration; SSE, SS with enumeration

Important: Unless otherwise stated, all samples were received in good condition. Results relate only to the items tested. Data is not corrected for blanks unless otherwise noted.

HydroQual Laboratories Ltd.
#3, 6125 12th Street SE Calgary, Alberta Canada T2H 2K1
Tel (403) 253-7121 Fax (403) 252-9363 www.hydroqual.ca

Test Report

Project: Alberta Environment
Sample Date: 2006/06/14
Analysis Date: 2006/06/14
Report Date: 2006/07/07
Reference No.: 06-1160

Method: HydroQual Method 4.4.1.32
References: See attached sheet

Sample ID	Identification
-1 Isolate 1	*Enterobacter*
-2 Isolate 2	*Bacillus*
-3 Isolate 3	*Escherichia coli*
-4 Isolate 4	*Chromobacterium*
-5 Isolate 5 (Dull yellow)	*Corynebacterium*
-6 Isolate 6 (White colony)	*Psuedomonas*
-7 Isolate 7 (Bright yellow)	*Alcaligenes*

The test data and results are verified correct.

Authorized by K. Steele, B.Sc., Quality Assurance Officer

HydroQual is certified by the Canadian Association of Environmental Analytical Laboratories (CAEAL) and the American Industrial Hygiene Association (AIHA) in the EMLAP. We comply with American, Canadian, and European standards for laboratory practice and the requirements of ISO/IEC Guide 17025 and CAN-P-4D, General Requirements for the Competence of Testing and Calibration Laboratories.

Our liability is limited to the cost of the test requested on the sample as received. No liability in whole or in part is assumed for the collection, handling or transport of the sample, application or interpretation of the test data or results in part or in whole.

HydroQual Laboratories Ltd.

#3, 6125 12th Street SE Calgary, Alberta Canada T2H 2K7
Tel (403) 253-7121 Fax (403) 252-9363 www.hydroqual.ca

Test Report

Project: Alberta Environment
Sample Date: 2006/06/14
Analysis Date: 2006/06/14
Report Date: 2006/07/07
Reference No.: 06-1160

Method: Total Coliforms and *Escherichia coli*; IDEXX
Reference: Enzyme Substrate Coliform Test, 9223B.
Standard Methods for the Examination of Water and Wastewater, 20th ed. 1998. L.S. Clesceri, A.E., Greenberg, and A.D. Eaton (eds.). APHA, AWWA, WEF, Washington. (ISBN 0-87553-235-7).

Sample ID	Test Type	Endpoint (Most Probable Number)	Result (After 48hrs)
-1	Total Coliform Bacteria	Not Applicable	None
Yellow colony	*Escherichia coli*	Not Applicable	None
-2	Total Coliform Bacteria	Not Applicable	None
White colony	*Escherichia coli*	Not Applicable	None
-3	Total Coliform Bacteria	Not Applicable	Present
Well	*Escherichia coli*	Not Applicable	Present
-4	Total Coliform Bacteria	Not Applicable	Present
Cistern 1	*Escherichia coli*	Not Applicable	Present
-5	Total Coliform Bacteria	Not Applicable	None
Cistern 2	*Escherichia coli*	Not Applicable	None

The test data and results are verified correct.

Authorized by K. Steele, B.Sc., Quality Assurance Officer

HydroQual is certified by the Canadian Association of Environmental Analytical Laboratories (CAEAL).
We comply with American, Canadian, and European standards for laboratory practice and the requirements of ISO/IEC Guide 17025 and CAN-P-4D, General Requirements for the Competence of Testing and Calibration Laboratories.
We participate in the American Industrial Hygiene Association's EMPAT program for proficiency testing in mould identification.
Our liability is limited to the cost of the test requested on the sample as received. No liability in whole or in part is assumued for the collection, handling or transport of the sample, application or interpretation of the test data or results in part or in whole.

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L450605-1 LM110206A								
Sampled By: CK/LM on 02-NOV-06 @ 13:05								
Matrix: WATER								
Routine Water Analysis								
Chloride (Cl)	238		0.1	mg/L		03-NOV-06	LPW	R463428
ICP metals for routine water								
Calcium (Ca)	1.5		0.5	mg/L		03-NOV-06	LPW	R462706
Potassium (K)	1.0		0.1	mg/L		03-NOV-06	LPW	R462706
Magnesium (Mg)	0.4		0.1	mg/L		03-NOV-06	LPW	R462706
Sodium (Na)	469		1	mg/L		03-NOV-06	LPW	R462706
Ion Balance Calculation								
Ion Balance	101			%		08-NOV-06		
TDS (Calculated)	1120			mg/L		08-NOV-06		
Hardness (as CaCO3)	5			mg/L		08-NOV-06		
Nitrate and Nitrite as N	<0.07		0.07	mg/L		08-NOV-06		
Nitrate-N	<0.05		0.05	mg/L		03-NOV-06	LPW	R463428
Nitrite-N	<0.05		0.05	mg/L		03-NOV-06	LPW	R463428
Sulphate (SO4)	0.9		0.5	mg/L		03-NOV-06	LPW	R463428
pH, Conductivity and Total Alkalinity								
pH	8.4		0.1	pH		03-NOV-06		R462745
Conductivity (EC)	1870		3	uS/cm		03-NOV-06		R462745
Bicarbonate (HCO3)	809		5	mg/L		03-NOV-06		R462745
Carbonate (CO3)	12		5	mg/L		03-NOV-06		R462745
Hydroxide (OH)	<5		5	mg/L		03-NOV-06		R462745
Alkalinity, Total (as CaCO3)	683		5	mg/L		03-NOV-06		R462745
L450605-2 LM110206B								
Sampled By: CK/LM on 02-NOV-06 @ 13:05								
Matrix: WATER								
Total & Fecal Coliform Count-MF								
MF - Fecal Coliforms	<1		1	CFU/100mL	03-NOV-06	14-NOV-06	RBD	R463402
MF - Total Coliforms	600	DLA	100	CFU/100mL	03-NOV-06	14-NOV-06	RBD	R463402
L450605-3 LM110206C								
Sampled By: CK/LM on 02-NOV-06 @ 13:05								
Matrix: WATER								
Iron Bacteria	9000		25	CFU/mL	03-NOV-06	14-NOV-06	RBD	R465196
L450605-4 LM110206D								
Sampled By: CK/LM on 02-NOV-06 @ 13:05								
Matrix: WATER								
Sulfur Reducing Bacteria	200		200	CFU/mL	03-NOV-06	14-NOV-06	RBD	R465194

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALBERTA RESEARCH COUNCIL | ORGANICS ANALYSIS DATA SHEET | ARC SAMPLE NUMBER: T06-3848

Client: Knaus

Sample No: Group Sample No: Site Descrip/Comment: Domestic Water Well Samples - Signer

Station No: Project No:

Agency: 34 Samp Type: SampMatrix: Collection: Samp Date: 2-Nov-06 Time: 1355 Samplers ID:

SubGroups	FILE	VMV	NAME	ConcRpt	MDL	ConcRptUnit	InjDate
DG_C1C4							
	W3848		Ethane	3.1		ug/L	9-Nov-06
	W3848		Ethylene	.4		ug/L	9-Nov-06
	W3848		Methane	34100.0		ug/L	9-Nov-06
DG_TCD							
	L3848		Carbon dioxide	7.2		mg/L	9-Nov-06
	L3848		Nitrogen	10.8		mg/L	9-Nov-06

[ARC_Remarks]: Dissolved Water Gas

SubGroups

DG_C1C4 and DG_TCD - Disolved Gas in water sample

G_C1C4 and G_TCD : free Gas from canister

Certified For: Yogesh Kumar, Business Unit Manager
Environmental Monitoring
By: Alberta Research Council
Vegreville, Alberta
T9C 1T4

Date: 15-Nov-06

Contact Person: Grant Prill
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta T9C 1T4
T9C 1T4

(780) 632-8455

Maxxam Analytics Inc

CARBON ISOTOPE ANALYSIS

A652812:D49395

Sample Point I.D. | Client I.D. | Meter Number | Laboratory Number

ALBERTA ENVIRONMENT

Operator Name | LSD | Well ID

ALBERTA ENVIRONMENT SIGNER | CK | ALBERTA ENVIRO.

Well Name | Name of Sampler | Company

GRAB | Tedlar Bag

Field or Area | Pool or Zone | Sample Point | Container Identity | Percent Full

Test Recovery | Sample Gathering Point | Solution Gas

Test Type | No. | Multiple Recovery | Interval 1 From: | Interval 2 | Interval 3 To: | Elevations (m) KB | GRD

N 0.000000 GPS | W 0.000000 GPS

Production Rates: Water m3/d | Oil m3/d | Gas 1000m3/d

Gauge Pressures kPa: Source | As Received

Temperature °C: Source | As Received

Well Fluid Type | Licence No.

Date Sampled Start	Date Sampled End	Date Received	Date Reported	Date Revision Reported	Analyst
2006/11/02 16:26		2006/11/06	2006/11/13	2006/11/13	MS2,MW

COMPOSITION

Component	Mole Fraction As Rec'd	ppm (v/v)	$\delta^{13}C$ ‰
H2	Trace		
He	Trace		
O2	0.0362		
N2	0.1515		
CO2	0.0021		-15.40
H2S	0.0000		
C1	0.8102		-65.66
C2	0.0000		-40.62
C3	0.0000		
IC4	0.0000		
NC4	0.0000		
IC5	0.0000		
NC5	0.0000		
C6	0.0000		
C7+	0.0000		
TOTAL	1.0000		

PROPERTIES

Calculated Mole Weight (Moisture Free as Sampled): 17.3 Total

Calculated Gross Heating Value (MJ/m3) @ 101.325 kPa & 15°C: 30.53 GPA 2172

Calculated Relative Densities Relative to Air @15°C: 0.598 Moisture Free as Sampled

Hydrogen Sulphide

On Site		In Lab	
Gastec (ppm v/v)	Tutwiler (mole%)	<1 Gastec (ppm v/v)	Tutwiler (mole%)

Onsite analysis is required for accurate source H2S content.
H2S degrades variably in all sample containers and is also matrix dependant.

$$\delta^{13}C\,‰ = [(^{13}C / ^{12}C_{sample} - ^{13}C / ^{12}C_{standard}) / (^{13}C / ^{12}C_{standard})] * 1000$$

INTERPRETATION

QC Check Std # 7633/1651 Date 2006/11/06 QC Passed Yes

** Information not supplied by client -- data derived from LSD information

Results relate only to items tested

Remarks:

CALGARY 2021-41 Avenue N.E., Calgary,Canada T2E 6P2 Tel: (403) 291-3077 Fax (403) 291-9458
EDMONTON 9331-48 Street, Edmonton, Canada T6B 2R4 Tel: (780) 468-3500 Fax (780) 468-3560
GRANDE PRAIRIE #105, 8502 - 112 Street, Grande Prairie, Canada T8V 5X4 Tel: (780) 532-0227 Fax (780) 532-0288
STETTLER Bay 6, 4705 - 42 Street, Stettler, Canada T0C2L0 Tel: (403) 742-1107 Fax (403) 742-0170

Maxxam Analytics Inc

CARBON ISOTOPE ANALYSIS

A652812:D49395

Sample Point I.D. | Client I.D. | Meter Number | Laboratory Number

ALBERTA ENVIRONMENT

Operator Name | NTS (BC Survey) | Well ID

ALBERTA ENVIRONMENT SIGNER | CK | ALBERTA ENVIRO.

Well Name | Name of Sampler | Company

GRAB | Tedlar Bag

Field or Area | Pool or Zone | Sample Point | Container Identity | Percent Full

Test Recovery | Sample Gathering Point | Solution Gas

Interval 1 | Interval 2 | Interval 3 — From: / To: | Elevations (m): KB / GRD

Test Type | No. | Multiple Recovery | Well Fluid Status | Well Status Mode

Production Rates: Water m3/d / Oil m3/d / Gas 1000m3/d | Gauge Pressures kPa: Source / As Received | Temperature °C: Source / As Received | Well Status Type | Well Type | Gas or Condensate Project | Licence No.

2006/11/02 16:26 | Date Sampled Start | Date Sampled End | 2006/11/06 Date Received | 2006/11/13 Date Reported | 2006/11/13 Date Revision Reported | MS2,MW Analyst

PARAMETER DESCRIPTION	Result	unit	VMV Code	MDL
Air Free As Received				
Mole Fraction Cyclopentane	<0.00001	mole/mole		0.00001
Mole Fraction n-Hexane	<0.00001	mole/mole		0.00001
Mole Fraction Methylcyclopentane	<0.00001	mole/mole		0.00001
Mole Fraction Benzene	<0.00001	mole/mole		0.00001
Mole Fraction Cyclohexane	<0.00001	mole/mole		0.00001
Mole Fraction 2,2,4 Trimethylpentane (TMP)	<0.00001	mole/mole		0.00001
Mole Fraction Methycyclohexane	<0.00001	mole/mole		0.00001
Mole Fraction Toluene	<0.00001	mole/mole		0.00001
Mole Fraction Ethylbenzene	<0.00001	mole/mole		0.00001
Mole Fraction m & p-Xylene	<0.00001	mole/mole		0.00001
Mole Fraction o-Xylene	<0.00001	mole/mole		0.00001
Mole Fraction 1,2,4 Trimethylbenzene (TMB)	<0.00001	mole/mole		0.00001
Physical Properties				
Calculated pPc: Acid Gas Free	4249.5	kPa		0.1
Calculated pTc: Acid Gas Free	173.9	°K		0.1
Calculated pPc: As Sampled	4256.1	kPa		0.1
Calculated pTc: As Sampled	174.2	°K		0.1
Volume Fraction				
Volume Fraction Cyclopentane	<0.01	ml/m3		0.01
Volume Fraction n-Hexane	<0.01	ml/m3		0.01
Volume Fraction Methylcyclopentane	<0.01	ml/m3		0.01
Volume Fraction Benzene	<0.01	ml/m3		0.01
Volume Fraction Cyclohexane	<0.01	ml/m3		0.01
Volume Fraction 2,2,4 Trimethylpentane (TMP)	<0.01	ml/m3		0.01
Volume Fraction Methycyclohexane	<0.01	ml/m3		0.01
Volume Fraction Toluene	<0.01	ml/m3		0.01
Volume Fraction Ethylbenzene	<0.01	ml/m3		0.01
Volume Fraction m & p-Xylene	<0.01	ml/m3		0.01
Volume Fraction o-Xylene	<0.01	ml/m3		0.01
Volume Fraction 1,2,4 Trimethylbenzene (TMB)	<0.01	ml/m3		0.01

** Information not supplied by client -- data derived from LSD information

Results relate only to items tested

Remarks:

Client: Knaus

Sample No: Group Sample No: Site Descrip/Comment: Signer Water Well

Station No: Project No:

Agency: 34 Samp Type: SampMatrix: Collection: Samp Date: 2-Nov-06 Time: 1627 Samplers ID:

SubGroups	FILE	VMV	NAME	ConcRpt	MDL	ConcRptUnit	InjDate
G_C1C4							
	C3850		Ethane	21.2	.1	ppmv	8-Nov-06
	C3850		Ethylene	0.0	.1	ppmv	8-Nov-06
G_TCD							
	G3850		Carbon dioxide	2390.0	300.0	ppm	8-Nov-06
	G3850		Methane	739000.0	300.0	ppm	8-Nov-06
	G3850		Nitrogen	264000.0	300.0	ppm	8-Nov-06

[ARC_Remarks]: WGas and VOC Screen

SubGroups

DG_C1C4 and DG_TCD - Disolved Gas in water sample

G_C1C4 and G_TCD - free Gas from canister

Certified For: Yogesh Kumar, Business Unit Manager
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta
T9C 1T4

By: _____

Date: 15-Nov-06

Contact Person: Grant Prill
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta T9C 1T4
T9C 1T4
(780) 632-8455

Maxxam Analytics Inc

CARBON ISOTOPE ANALYSIS

Sample Point I.D.	Client I.D.	Meter Number	Laboratory Number
			A652812:D49356

Operator Name	LSD	Well ID
ALBERTA ENVIRONMENT		

Well Name	Name of Sampler	Company
ALBERTA ENVIRONMENT SIGNER	CK	ALBERTA ENVIRO.

Field or Area	Pool or Zone	Sample Point	Container Identity	Percent Full
		GRAB	Tedlar Bag	

Test Recovery	Sample Gathering Point	Solution Gas

Test Type / No. / Multiple Recovery

Interval 1 / Interval 2 / Interval 3 — From: / To:

Elevations (m): KB / GRD

N 0.000000 GPS — W 0.000000 GPS

Production Rates: Water m3/d / Oil m3/d / Gas 1000m3/d

Gauge Pressures kPa: Source / As Received

Temperature °C: Source / As Received

Well Fluid Type — Licence No.

Date Sampled Start	Date Sampled End	Date Received	Date Reported	Date Revision Reported	Analyst
2006/11/02 16:28		2006/11/06	2006/11/13	2006/11/13	MS2,MW

COMPOSITION

Component	Mole Fraction As Rec'd	ppm (v/v)	$\delta^{13}C$ ‰
H2	Trace		
He	Trace		
O2	0.0284		
N2	0.1263		
CO2	0.0022		-16.66
H2S	0.0000		
C1	0.8431		-68.09
C2	0.0000		-40.11
C3	0.0000		
IC4	0.0000		
NC4	0.0000		
IC5	0.0000		
NC5	0.0000		
C6	0.0000		
C7+	0.0000		
TOTAL	1.0000		

PROPERTIES

Calculated Mole Weight — Moisture Free as Sampled: 17.2 (Total)

Calculated Gross Heating Value (MJ/m3) — @ 101.325 kPa & 15°C: 31.77 (GPA 2172)

Calculated Relative Densities — Relative to Air @15°C: 0.592 (Moisture Free as Sampled)

Hydrogen Sulphide

On Site		In Lab	
Gastec (ppm v/v)	Tutwiler (mole%)	<1 Gastec (ppm v/v)	Tutwiler (mole%)

Onsite analysis is required for accurate source H2S content.
H2S degrades variably in all sample containers and is also matrix dependant.

$$\delta^{13}C\ ‰ = [(^{13}C / ^{12}C_{sample} - {}^{13}C / {}^{12}C_{standard}) / (^{13}C / ^{12}C_{standard})] * 1000$$

INTERPRETATION

QC Check Std # 7633/1651 Date 2006/11/06 QC Passed Yes

** Information not supplied by client -- data derived from LSD information

Results relate only to items tested

Remarks:

CALGARY 2021-41 Avenue N.E., Calgary,Canada T2E 6P2 Tel: (403) 291-3077 Fax (403) 291-9468
EDMONTON 9331-48 Street, Edmonton, Canada T6B 2R4 Tel: (780) 468-3500 Fax (780) 468-3560
GRANDE PRAIRIE #105, 8502 - 112 Street, Grande Prairie, Canada T8V 5X4 Tel: (780) 532-0227 Fax (780) 532-0288
STETTLER Bay 6, 4705 - 42 Street, Stettler, Canada T0C2L0 Tel: (403) 742-1107 Fax (403) 742-0170

Maxxam Analytics Inc

CARBON ISOTOPE ANALYSIS

A652812:D49356

Sample Point I.D. | Client I.D. | Meter Number | Laboratory Number

ALBERTA ENVIRONMENT

Operator Name | NTS (BC Survey) | Well ID

ALBERTA ENVIRONMENT SIGNER | CK | ALBERTA ENVIRO.

Well Name | Name of Sampler | Company

GRAB | Tedlar Bag

Field or Area | Pool or Zone | Sample Point | Container Identity | Percent Full

Test Recovery | Interval 1 | Interval 2 | Interval 3 | Elevations (m) | Sample Gathering Point | Solution Gas

Test Type | No. | Multiple Recovery | From: | To: | KB | GRD | Well Fluid Status | Well Status Mode

Production Rates: Water m3/d | Oil m3/d | Gas 1000m3/d

Gauge Pressures kPa: Source | As Received

Temperature °C: Source | As Received

Well Status Type | Well Type | Gas or Condensate Project | Licence No.

Date Sampled Start	Date Sampled End	Date Received	Date Reported	Date Revision Reported	Analyst
2006/11/02 16:28		2006/11/06	2006/11/13	2006/11/13	MS2,MW

PARAMETER DESCRIPTION	Result	unit	VMV Code	MDL
Air Free As Received				
Mole Fraction Cyclopentane	<0.00001	mole/mole		0.00001
Mole Fraction n-Hexane	<0.00001	mole/mole		0.00001
Mole Fraction Methylcyclopentane	<0.00001	mole/mole		0.00001
Mole Fraction Benzene	<0.00001	mole/mole		0.00001
Mole Fraction Cyclohexane	<0.00001	mole/mole		0.00001
Mole Fraction 2,2,4 Trimethylpentane (TMP)	<0.00001	mole/mole		0.00001
Mole Fraction Methycyclohexane	<0.00001	mole/mole		0.00001
Mole Fraction Toluene	<0.00001	mole/mole		0.00001
Mole Fraction Ethylbenzene	<0.00001	mole/mole		0.00001
Mole Fraction m & p-Xylene	<0.00001	mole/mole		0.00001
Mole Fraction o-Xylene	<0.00001	mole/mole		0.00001
Mole Fraction 1,2,4 Trimethylbenzene (TMB)	<0.00001	mole/mole		0.00001
Physical Properties				
Calculated pPc: Acid Gas Free	4316.0	kPa		0.1
Calculated pTc: Acid Gas Free	177.0	°K		0.1
Calculated pPc: As Sampled	4322.8	kPa		0.1
Calculated pTc: As Sampled	177.3	°K		0.1
Volume Fraction				
Volume Fraction Cyclopentane	<0.01	ml/m3		0.01
Volume Fraction n-Hexane	<0.01	ml/m3		0.01
Volume Fraction Methylcyclopentane	<0.01	ml/m3		0.01
Volume Fraction Benzene	<0.01	ml/m3		0.01
Volume Fraction Cyclohexane	<0.01	ml/m3		0.01
Volume Fraction 2,2,4 Trimethylpentane (TMP)	<0.01	ml/m3		0.01
Volume Fraction Methycyclohexane	<0.01	ml/m3		0.01
Volume Fraction Toluene	<0.01	ml/m3		0.01
Volume Fraction Ethylbenzene	<0.01	ml/m3		0.01
Volume Fraction m & p-Xylene	<0.01	ml/m3		0.01
Volume Fraction o-Xylene	<0.01	ml/m3		0.01
Volume Fraction 1,2,4 Trimethylbenzene (TMB)	<0.01	ml/m3		0.01

** Information not supplied by client -- data derived from LSD information

Results relate only to items tested

Remarks:

Maxxam Job #: A652812
Report Date: 2006/11/13

ALBERTA ENVIRONMENT
Client Project #: ROSEBUD (PRE-CLEAN)
Site Reference: SIGNER
Sampler Initials:

RESULTS OF CHEMICAL ANALYSES OF GAS

Maxxam ID		D49356	D49395	
Sampling Date		11/2/2006 16:28	11/2/2006 16:26	
COC Number		149634	149634	
	Units	**ALBERTA ENVIRONMENT SIGNER**	**ALBERTA ENVIRONMENT SIGNER**	**RDL**
Parameter				
PPM Hexanes (C6)	ppm	0	0	N/A
Temporary				
PPM Heptanes Plus	ppm	0	0	N/A
Air Free As Received				
Mole Fraction Cyclopentane	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Hydrogen	mole/mole	TRACE	TRACE	0.0001
Mole Fraction Helium	mole/mole	TRACE	TRACE	0.0001
Mole Fraction n-Hexane	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Methylcyclopentane	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Benzene	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Oxygen	mole/mole	0.0284	0.0362	0.0001
Mole Fraction Cyclohexane	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Nitrogen	mole/mole	0.1263	0.1515	0.0001
Mole Fraction 2,2,4 Trimethylpentane (TMP)	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Carbon Dioxide	mole/mole	0.0022	0.0021	0.0001
Mole Fraction Hydrogen Sulphide (H2S)	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction Methycyclohexane	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Methane (C1)	mole/mole	0.8431	0.8102	0.0001
Mole Fraction Toluene	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Ethane (C2)	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction Ethylbenzene	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction m & p-Xylene	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction Propane (C3)	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction Isobutane	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction o-Xylene	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction 1,2,4 Trimethylbenzene (TMB)	mole/mole	<0.00001	<0.00001	0.00001
Mole Fraction n-Butane	mole/mole	<0.0001	<0.0001	0.0001

Mole Fraction Isopentane	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction n-Pentane	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction Hexanes (C6)	mole/mole	<0.0001	<0.0001	0.0001
Mole Fraction Total Fraction	mole/mole	1	1	0.0001
Mole Fraction Heptanes Plus	mole/mole	<0.0001	<0.0001	0.0001
Carbon Isotope Abundance				
Carbon Isotope Carbon Dioxide	PDB	-16.66	-15.4	N/A
Carbon Isotope Methane (C1)	PDB	-68.09	-65.66	N/A
Carbon Isotope Ethane (C2)	PDB	-40.11	-40.62	N/A
GAS				
In Laboratory Hydrogen Sulphide (H2S)	ppm (mole)	<1	<1	1
Physical Properties				
Calculated Gross Heating Value As Sampled	Mj/m3	31.77	30.53	0.01
Calculated pPc: Acid Gas Free	kPa	4316	4249.5	0.1
Calculated pTc: Acid Gas Free	°K	177	173.9	0.1
Calculated QC Check Std#	N/A	7633/1651	7633/1651	N/A
Calculated Relative Density Moisture Free	N/A	0.592	0.598	0.001
Calculated pPc: As Sampled	kPa	4322.8	4256.1	0.1
Calculated pTc: As Sampled	°K	177.3	174.2	0.1
Calculated Molecular Weight Total	g/mole	17.2	17.3	0.1
Volume Fraction				
Volume Fraction Cyclopentane	ml/m3	<0.01	<0.01	0.01
Volume Fraction n-Hexane	ml/m3	<0.01	<0.01	0.01
Volume Fraction Methylcyclopentane	ml/m3	<0.01	<0.01	0.01
Volume Fraction Benzene	ml/m3	<0.01	<0.01	0.01
Volume Fraction Cyclohexane	ml/m3	<0.01	<0.01	0.01
Volume Fraction 2,2,4 Trimethylpentane (TMP)	ml/m3	<0.01	<0.01	0.01
Volume Fraction Methycyclohexane	ml/m3	<0.01	<0.01	0.01
Volume Fraction Toluene	ml/m3	<0.01	<0.01	0.01
Volume Fraction Ethylbenzene	ml/m3	<0.01	<0.01	0.01
Volume Fraction m & p-Xylene	ml/m3	<0.01	<0.01	0.01
Volume Fraction o-Xylene	ml/m3	<0.01	<0.01	0.01
Volume Fraction 1,2,4 Trimethylbenzene (TMB)	ml/m3	<0.01	<0.01	0.01

RDL = Reportable Detection Limit

Client: Knaus

Sample No: Group Sample No: Site Descrip/Comment: Domestic Water Well Samples - Signer (2)

Station No: Project No:

Agency: 34 Samp Type: SampMatrix: Collection: Samp Date: 2-Nov-06 Time: 1631 Samplers ID:

SubGroups	FILE	VMV	NAME	ConcRpt	MDL	ConcRptUnit	InjDate
G_C1C4							
	C3849		Ethane	13.4	.1	ppmv	8-Nov-06
	C3849		Ethylene	0.0	.1	ppmv	8-Nov-06
G_TCD							
	G3849		Carbon dioxide	1800.0	300.0	ppm	8-Nov-06
	G3849		Methane	932000.0	300.0	ppm	8-Nov-06
	G3849		Nitrogen	98000.0	300.0	ppm	8-Nov-06

[ARC_Remarks]: WGas and VOC Screen

SubGroups

DG_C1C4 and DG_TCD - Disolved Gas in water sample

G_C1C4 and G_TCD - free Gas from canister

Certified For: Yogesh Kumar, Business Unit Manager
Environmental Monitoring
By: Alberta Research Council
Vegreville, Alberta
T9C 1T4

Date: 15-Nov-06

Contact Person: Grant Prill
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta T9C 1T4
T9C 1T4
(780) 632-8455

Alberta Research Council
Environmental Monitoring
Vegreville, Alberta

Tabular Data Report

Sample No: T06-3849 Comments: Domestic Water Well Samples - Signer (2)
SmpDate: 2-Nov-06 Time: 1631 By: CK Matrix: SILCO
Canister #: 1925 User Sample No:

	SubGroup: voz14			Concentration			
FILE	RT	MQ	NAME	ppbv	MW	MolFormula	CAS
	Analysis Date: 09-NOV-2006 12:32						
V3849	0.00	T	Freon-12	0.0	121	CCl2F2	75-71-8
V3849	0.00	T	Chloromethane	0.0	50	CH3Cl	74-87-3
V3849	0.00	T	Freon-114	0.0	171	C2Cl2F4	76-14-2
V3849	0.00	T	Vinyl chloride	0.0	63	C2H3Cl	75-01-4
V3849	0.00	T	trans-2-Butene	0.0	56	C4H8	624-64-6
V3849	0.00	T	cis-2-Butene	0.0	56	C4H8	590-18-1
V3849	0.00	T	Bromomethane	0.0	95	CH3Br	74-83-9
V3849	0.00	T	Chloroethane	0.0	65	C2H5Cl	75-00-3
V3849	0.00	T	3-Methyl-1-butene	0.0	70	C5H10	563-45-1
V3849	0.00	T	Freon-11	0.0	137	CCl3F	75-69-4
V3849	0.00	T	1-Pentene	0.0	70	C5H10	109-67-1
V3849	0.00	T	Isoprene	0.0	68	C5H8	78-79-5
V3849	0.00	T	trans-2-Pentene	0.0	70	C5H10	646-04-8
V3849	0.00	T	cis-2-Pentene	0.0	70	C5H10	627-20-3
V3849	0.00	T	1,1-Dichloroethylene	0.0	96	C2H2Cl2	75-35-4
V3849	0.00	T	2-Methyl-2-butene	0.0	70	C5H10	563-46-2
V3849	0.00	T	Freon-113	0.0	187	C2Cl3F3	76-13-1
V3849	0.00	T	Methylene chloride	0.0	84	CH2Cl2	75-09-2
V3849	0.00	T	Cyclopentene	0.0	68	C5H8	142-29-0
V3849	0.00	T	4-Methyl-1-pentene	0.0	84	C6H12	691-37-2
V3849	0.00	T	Cyclopentane	0.0	70	C5H10	287-92-3
V3849	0.00	T	1,1-Dichloroethane	0.0	98	C2H4Cl2	75-34-3
V3849	0.00	T	cis-2-Hexene	0.0	84	C6H12	7688-21-3
V3849	0.00	T	cis-1,2-Dichloroethylene	0.0	97	C2H2Cl2	156-59-4
V3849	0.00	T	trans-2-Hexene	0.0	84	C6H12	4050-45-7
V3849	0.00	T	Chloroform	0.0	119	CHCl3	67-66-3
V3849	0.00	T	2,4-Dimethylpentane	0.0	100	C7H16	108-08-7
V3849	0.00	T	1,1,1-Trichloroethane	0.0	132	C2H3Cl3	71-55-6
V3849	0.00	T	1,2-Dichloroethane	0.0	98	C2H4Cl2	107-06-2
V3849	0.00	T	Carbon tetrachloride	0.0	154	CCl4	56-23-5
V3849	0.00	T	2-Methylhexane	0.0	100	C7H16	591-76-4
V3849	0.00	T	2,3-Dimethylpentane	0.0	100	C7H16	565-59-3
V3849	0.00	T	3-Methylhexane	0.0	100	C7H16	589-34-4
V3849	0.00	T	1,2-Dichloropropane	0.0	113	C3H6Cl2	78-87-5
V3849	0.00	T	Trichloroethylene	0.0	131	C2HCl3	79-01-6
V3849	0.00	T	Methylcyclohexane	0.0	98	C7H14	108-87-2
V3849	0.00	T	cis-1,3-Dichloropropylene	0.0	111	C3H4Cl2	542-75-6
V3849	0.00	T	2-Methylheptane	0.0	114	C8H18	592-27-8
V3849	0.00	T	trans-1,3-Dichloropropylene	0.0	111	C3H4Cl2	542-75-6
V3849	0.00	T	3-Methylheptane	0.0	114	C8H18	589-81-1
V3849	0.00	T	trans-1,2-Dichloroethylene	0.0	97	C2H2Cl2	156-60-5
V3849	0.00	T	1,1,2-Trichloroethane	0.0	132	C2H3Cl3	79-00-5

Sample No: T06-3849 Comments: Domestic Water Well Samples - Signer (2)
SmpDate: 2-Nov-06 Time: 1631 By: CK Matrix: SILCO
Canister #: 1925 User Sample No:

SubGroup: voz14

FILE	RT	MQ	NAME	Concentration ppbv	MW	MolFormula	CAS
Analysis Date: 09-NOV-2006 12:32							
V3849	0.00	T	1,2-Dibromoethane	0.0	188	C2H4Br2	106-93-4
V3849	0.00	T	Tetrachloroethylene	0.0	166	C2Cl4	127-18-4
V3849	0.00	T	Chlorobenzene	0.0	113	C6H5Cl	108-90-7
V3849	0.00	T	Styrene	0.0	104	C8H8	100-42-5
V3849	0.00	T	1,1,2,2-Tetrachloroethane	0.0	166	C2H2Cl4	79-34-5
V3849	0.00	T	n-Propylbenzene	0.0	120	C9H12	103-65-1
V3849	0.00	T	1,3,5-Trimethylbenzene	0.0	120	C9H12	108-67-8
V3849	0.00	T	beta Pinene	0.0	136	C10H16	18172-67-3
V3849	0.00	T	1,2,4-Trimethylbenzene	0.0	120	C9H12	95-63-6
V3849	0.00	T	1,3-Dichlorobenzene	0.0	147	C6H4Cl2	541-73-1
V3849	0.00	T	1,4-Dichlorobenzene	0.0	147	C6H4Cl2	106-46-7
V3849	0.00	T	1,2-Dichlorobenzene	0.0	146	C6H4Cl2	95-50-1
V3849	0.00	T	1,2,4-Trichlorobenzene	0.0	180	C6H3Cl3	120-82-1
V3849	0.00	T	Hexachlorobutadiene	0.0	261	C4Cl6	87-68-3
V3849	2.54	90	Sulfur dioxide(DOT)	3.1	64	O2S	7446-09-5
V3849	2.58	91	Cyclopropane	30.8	42	C3H6	75-19-4
V3849	2.67	T	Isobutane	15.4	58	C4H10	75-28-5
V3849	2.83	T	1-Butene	7.3	56	C4H8	106-98-9
V3849	2.87	T	Butane	8.3	58	C4H10	106-97-8
V3849	2.97	78	Propane, 2,2-dimethyl-	19.1	72	C5H12	463-82-1
V3849	3.55	T	Isopentane	9.8	72	C5H12	78-78-4
V3849	3.88	T	Pentane	1.6	72	C5H12	109-66-0
V3849	4.34	T	2,2-Dimethylbutane	1.6	86	C6H14	75-83-2
V3849	4.74	25	3-Methylenecyclohexene	1.5	94	C7H10	13407-18-6
V3849	4.80	T	2,3-Dimethylbutane	1.3	86	C6H14	79-29-8
V3849	4.86	T	2-Methylpentane	.9	86	C6H14	107-83-5
V3849	5.09	T	3-Methylpentane	1.6	86	C6H14	96-14-0
V3849	5.24	T	2-Methyl-1-pentene	4.8	84	C6H12	763-29-1
V3849	5.37	T	Hexane	10.7	86	C6H14	110-54-3
V3849	5.86	T	Methylcyclopentane	1.7	84	C6H12	96-37-7
V3849	6.44	T	Cyclohexane	.3	84	C6H12	110-82-7
V3849	6.45	T	Benzene	.5	78	C6H6	71-43-2
V3849	6.83	T	2,2,4-Trimethylpentane	.5	114	C8H18	540-84-1
V3849	6.89	76	1-Heptene	1.1	98	C7H14	592-41-7
V3849	7.03	T	Heptane	.7	100	C7H16	142-82-5
V3849	7.24	52	1-Pentene, 2,4,4-trimethyl-	1.2	112	C8H16	107-39-1
V3849	7.45	62	Cyclohexane, methyl-	.6	98	C7H14	108-87-2
V3849	7.86	T	2,3,4-Trimethylpentane	.2	114	C8H18	565-75-3
V3849	8.17	T	Toluene	1.8	92	C7H8	108-88-3
V3849	8.48	91	trans-1-Butyl-2-methylcyclopropane	8.0	112	C8H16	38851-70-6
V3849	8.57	76	4-Octene, (E)-	.8	112	C8H16	14850-23-8
V3849	8.61	T	Octane	8.0	114	C8H18	111-65-9
V3849	8.77	83	ETHYL-2 HEXENE-1	3.1	112	C8H16	37266-23-2
V3849	9.40	I	Chlorobenzene-d5	18.0	112	C6D5Cl	3114-55-4
V3849	9.64	T	Ethyl benzene	.7	106	C8H10	100-41-4
V3849	9.75	T	m,p-Xylene	1.2	106	C8H10	108-38-3 / 106-42-3
V3849	10.08	T	Nonane	.5	128	C9H20	111-84-2
V3849	10.12	T	o-Xylene	1.3	106	C8H10	95-47-6
V3849	10.56	T	Isopropylbenzene	.3	120	C9H12	98-82-8
V3849	10.72	T	alpha Pinene	.5	136	C10H16	80-56-8

Sample No: T06-3849 Comments: Domestic Water Well Samples - Signer (2)

SmpDate: 2-Nov-06 Time: 1631 By: CK Matrix: SILCO

Canister #: 1925 User Sample No:

SubGroup: voz14

FILE	RT	MQ	NAME	Concentration ppbv	MW	MolFormula	CAS
	Analysis Date: 09-NOV-2006 12:32						
V3849	10.78	38	4-Methylcyclohexene	.4	96	C7H12	0-00-0
V3849	10.97	27	2-Decene, (Z)-	.5	140	C10H20	20348-51-0
V3849	11.07	68	cis-4-Decene	3.0	140	C10H20	19398-88-0
V3849	11.24	47	4-Nonene, 5-methyl-	6.0	140	C10H20	15918-07-7
V3849	11.33	96	1-Decene	4.0	140	C10H20	872-05-9
V3849	11.38	95	5-Decene, (E)-	4.3	140	C10H20	7433-56-9
V3849	11.44	53	Tridecane	.9	184	C13H28	629-50-5
V3849	11.62	72	4-methylene-5-hexen-2-ol	5.1	112	C7H12O	71885-98-8
			sum:	193			

Sample No: T06-3850 Comments: Signer Water Well

SmpDate: 2-Nov-06 Time: 1627 By: CK/LM Matrix: SILCO

Canister #: 2132 User Sample No:

SubGroup: voz14

FILE	RT	MQ	NAME	Concentration ppbv	MW	MolFormula	CAS
Analysis Date: 09-NOV-2006 13:07							
V3850	0.00	T	Freon-12	0.0	121	CCl2F2	75-71-8
V3850	0.00	T	Chloromethane	0.0	50	CH3Cl	74-87-3
V3850	0.00	T	Freon-114	0.0	171	C2Cl2F4	76-14-2
V3850	0.00	T	Vinyl chloride	0.0	63	C2H3Cl	75-01-4
V3850	0.00	T	trans-2-Butene	0.0	56	C4H8	624-64-6
V3850	0.00	T	cis-2-Butene	0.0	56	C4H8	590-18-1
V3850	0.00	T	Bromomethane	0.0	95	CH3Br	74-83-9
V3850	0.00	T	Chloroethane	0.0	65	C2H5Cl	75-00-3
V3850	0.00	T	3-Methyl-1-butene	0.0	70	C5H10	563-45-1
V3850	0.00	T	Freon-11	0.0	137	CCl3F	75-69-4
V3850	0.00	T	1-Pentene	0.0	70	C5H10	109-67-1
V3850	0.00	T	Isoprene	0.0	68	C5H8	78-79-5
V3850	0.00	T	trans-2-Pentene	0.0	70	C5H10	646-04-8
V3850	0.00	T	cis-2-Pentene	0.0	70	C5H10	627-20-3
V3850	0.00	T	1,1-Dichloroethylene	0.0	96	C2H2Cl2	75-35-4
V3850	0.00	T	2-Methyl-2-butene	0.0	70	C5H10	563-46-2
V3850	0.00	T	Freon-113	0.0	187	C2Cl3F3	76-13-1
V3850	0.00	T	Methylene chloride	0.0	84	CH2Cl2	75-09-2
V3850	0.00	T	Cyclopentene	0.0	68	C5H8	142-29-0
V3850	0.00	T	4-Methyl-1-pentene	0.0	84	C6H12	691-37-2
V3850	0.00	T	Cyclopentane	0.0	70	C5H10	287-92-3
V3850	0.00	T	1,1-Dichloroethane	0.0	98	C2H4Cl2	75-34-3
V3850	0.00	T	cis-2-Hexene	0.0	84	C6H12	7688-21-3
V3850	0.00	T	cis-1,2-Dichloroethylene	0.0	97	C2H2Cl2	156-59-4
V3850	0.00	T	trans-2-Hexene	0.0	84	C6H12	4050-45-7
V3850	0.00	T	Chloroform	0.0	119	CHCl3	67-66-3
V3850	0.00	T	2,4-Dimethylpentane	0.0	100	C7H16	108-08-7
V3850	0.00	T	1,1,1-Trichloroethane	0.0	132	C2H3Cl3	71-55-6
V3850	0.00	T	1,2-Dichloroethane	0.0	98	C2H4Cl2	107-06-2
V3850	0.00	T	Carbon tetrachloride	0.0	154	CCl4	56-23-5
V3850	0.00	T	2-Methylhexane	0.0	100	C7H16	591-76-4
V3850	0.00	T	2,3-Dimethylpentane	0.0	100	C7H16	565-59-3
V3850	0.00	T	3-Methylhexane	0.0	100	C7H16	589-34-4
V3850	0.00	T	1,2-Dichloropropane	0.0	113	C3H6Cl2	78-87-5
V3850	0.00	T	Trichloroethylene	0.0	131	C2HCl3	79-01-6
V3850	0.00	T	cis-1,3-Dichloropropylene	0.0	111	C3H4Cl2	542-75-6
V3850	0.00	T	2-Methylheptane	0.0	114	C8H18	592-27-8
V3850	0.00	T	trans-1,3-Dichloropropylene	0.0	111	C3H4Cl2	542-75-6
V3850	0.00	T	3-Methylheptane	0.0	114	C8H18	589-81-1
V3850	0.00	T	trans-1,2-Dichloroethylene	0.0	97	C2H2Cl2	156-60-5
V3850	0.00	T	1,1,2-Trichloroethane	0.0	132	C2H3Cl3	79-00-5
V3850	0.00	T	1,2-Dibromoethane	0.0	188	C2H4Br2	106-93-4
V3850	0.00	T	Tetrachloroethylene	0.0	166	C2Cl4	127-18-4
V3850	0.00	T	Chlorobenzene	0.0	113	C6H5Cl	108-90-7
V3850	0.00	T	Styrene	0.0	104	C8H8	100-42-5
V3850	0.00	T	1,1,2,2-Tetrachloroethane	0.0	166	C2H2Cl4	79-34-5
V3850	0.00	T	n-Propylbenzene	0.0	120	C9H12	103-65-1
V3850	0.00	T	beta Pinene	0.0	136	C10H16	18172-67-3
V3850	0.00	T	1,2,4-Trimethylbenzene	0.0	120	C9H12	95-63-6
V3850	0.00	T	1,3-Dichlorobenzene	0.0	147	C6H4Cl2	541-73-1

Sample No: T06-3850 Comments: Signer Water Well

SmpDate: 2-Nov-06 Time: 1627 By: CK/LM Matrix: SILCO

Canister #: 2132 User Sample No:

SubGroup: voz14

FILE	RT	MQ	NAME	Concentration ppbv	MW	MolFormula	CAS
Analysis Date: 09-NOV-2006 13:07							
V3850	0.00	T	1,4-Dichlorobenzene	0.0	147	C6H4Cl2	106-46-7
V3850	0.00	T	1,2-Dichlorobenzene	0.0	146	C6H4Cl2	95-50-1
V3850	0.00	T	1,2,4-Trichlorobenzene	0.0	180	C6H3Cl3	120-82-1
V3850	0.00	T	Hexachlorobutadiene	0.0	261	C4Cl6	87-68-3
V3850	2.54	83	Sulfur dioxide	.9	64	O2S	7446-09-5
V3850	2.58	91	Cyclopropane	31.0	42	C3H6	75-19-4
V3850	2.68	T	Isobutane	15.2	58	C4H10	75-28-5
V3850	2.83	T	1-Butene	12.8	56	C4H8	106-98-9
V3850	2.88	T	Butane	8.1	58	C4H10	106-97-8
V3850	2.97	78	Propane, 2,2-dimethyl-	19.2	72	C5H12	463-82-1
V3850	3.55	T	Isopentane	9.4	72	C5H12	78-78-4
V3850	3.88	T	Pentane	1.6	72	C5H12	109-66-0
V3850	4.34	T	2,2-Dimethylbutane	1.6	86	C6H14	75-83-2
V3850	4.80	T	2,3-Dimethylbutane	1.2	86	C6H14	79-29-8
V3850	4.87	T	2-Methylpentane	.7	86	C6H14	107-83-5
V3850	5.09	T	3-Methylpentane	1.6	86	C6H14	96-14-0
V3850	5.24	T	2-Methyl-1-pentene	4.3	84	C6H12	763-29-1
V3850	5.37	T	Hexane	8.4	86	C6H14	110-54-3
V3850	5.86	T	Methylcyclopentane	1.5	84	C6H12	96-37-7
V3850	6.44	T	Cyclohexane	.3	84	C6H12	110-82-7
V3850	6.45	T	Benzene	.5	78	C6H6	71-43-2
V3850	6.83	T	2,2,4-Trimethylpentane	.6	114	C8H18	540-84-1
V3850	6.89	58	1-Heptene	1.1	98	C7H14	592-41-7
V3850	7.03	T	Heptane	.6	100	C7H16	142-82-5
V3850	7.23	49	1-Pentene, 2,4,4-trimethyl-	1.1	112	C8H16	107-39-1
V3850	7.45	T	Methylcyclohexane	.3	98	C7H14	108-87-2
V3850	7.85	T	2,3,4-Trimethylpentane	.2	114	C8H18	565-75-3
V3850	7.95	40	Pentane, 2,3,3-trimethyl-	.4	114	C8H18	560-21-4
V3850	8.18	T	Toluene	2.0	92	C7H8	108-88-3
V3850	8.48	87	1-Octene	6.9	112	C8H16	111-66-0
V3850	8.56	58	Cyclohexanone, 4-methyl-	.5	112	C7H12O	589-92-4
V3850	8.61	T	Octane	6.7	114	C8H18	111-65-9
V3850	8.77	72	Heptane, 3-methylene-	2.6	112	C8H16	1632-16-2
V3850	8.87	59	6 METHYL-2 PHENYLINDOLE	.4	207	C15H13N	0-00-0
V3850	9.40	I	Chlorobenzene-d5	18.0	112	C6D5Cl	3114-55-4
V3850	9.64	T	Ethyl benzene	.8	106	C8H10	100-41-4
V3850	9.75	T	m,p-Xylene	1.2	106	C8H10	108-38-3 / 106-42-3
V3850	10.08	T	Nonane	.3	128	C9H20	111-84-2
V3850	10.11	T	o-Xylene	1.3	106	C8H10	95-47-6
V3850	10.32	42	Cyclopentanemethanamine, 2-amino-	.3	114	C6H14N2	21544-02-5
V3850	10.56	T	Isopropylbenzene	1.3	120	C9H12	98-82-8
V3850	10.72	T	alpha Pinene	.4	136	C10H16	80-56-8
V3850	10.78	30	2,4-Hexadien-1-ol	.3	98	C6H10O	111-28-4
V3850	10.97	12	Piperidine, 1-nitro-	.3	130	C5H10N2O2	7119-94-0
V3850	11.07	83	Cyclopentane, pentyl-	2.6	140	C10H20	3741-00-2
V3850	11.16	T	1,3,5-Trimethylbenzene	.3	120	C9H12	108-67-8
V3850	11.34	96	1-Decene	2.6	140	C10H20	872-05-9
V3850	11.38	93	cis-4-Decene	3.3	140	C10H20	19398-88-0
V3850	11.44	80	1-Decanol, 2-methyl-	.7	172	C11H24O	18675-24-6
V3850	11.62	87	3-Heptene, 2,2,4,6,6-pentamethyl-	4.9	168	C12H24	123-48-8

Sample No: T06-3850 Comments: Signer Water Well

SmpDate: 2-Nov-06 Time: 1627 By: CK/LM Matrix: SILCO

Canister #: 2132 User Sample No:

SubGroup: voz14

FILE	RT	MQ	NAME	Concentration ppbv	MW	MolFormula	CAS

Analysis Date: 09-NOV-2006 13:07

sum: 181

Certified For: Yogesh Kumar, Business Unit Manager
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta
T9C 1T4

By:

Date:

Contact Person: Grant Prill
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta T9C 1T4
T9C 1T4
(780) 632-8455

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L481117-6 H								
Sampled By: NOT PROVIDED on 22-FEB-07 @ 12:30								
Matrix: WATER								
Total Metals								
Total Major Metals								
Calcium (Ca)	3.7		0.5	mg/L		26-FEB-07	HAS	R497055
Potassium (K)	0.9		0.1	mg/L		27-FEB-07	HAS	R497498
Magnesium (Mg)	0.4		0.1	mg/L		26-FEB-07	HAS	R497055
Sodium (Na)	431		1	mg/L		26-FEB-07	HAS	R497055
Iron (Fe)	1.06		0.005	mg/L		26-FEB-07	HAS	R497055
Manganese (Mn)	0.012		0.001	mg/L		26-FEB-07	HAS	R497055
Total Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		26-FEB-07	CVM	R497347
Aluminum (Al)	0.03		0.01	mg/L		26-FEB-07	CVM	R497347
Boron (B)	0.36		0.05	mg/L		26-FEB-07	CVM	R497347
Barium (Ba)	0.132		0.003	mg/L		26-FEB-07	CVM	R497347
Beryllium (Be)	<0.002		0.002	mg/L		26-FEB-07	CVM	R497347
Cadmium (Cd)	<0.001		0.001	mg/L		26-FEB-07	CVM	R497347
Cobalt (Co)	<0.002		0.002	mg/L		26-FEB-07	CVM	R497347

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L481117-6 H								
Sampled By: NOT PROVIDED on 22-FEB-07 @ 12:30								
Matrix: WATER								
Total Metals								
Total Trace Metals								
Chromium (Cr)	0.005		0.005	mg/L		26-FEB-07	CVM	R497347
Copper (Cu)	<0.001		0.001	mg/L		26-FEB-07	CVM	R497347
Molybdenum (Mo)	<0.005		0.005	mg/L		26-FEB-07	CVM	R497347
Nickel (Ni)	<0.002		0.002	mg/L		26-FEB-07	CVM	R497347
Lead (Pb)	<0.005		0.005	mg/L		26-FEB-07	CVM	R497347
Tin (Sn)	<0.05		0.05	mg/L		26-FEB-07	CVM	R497347
Strontium (Sr)	0.108		0.002	mg/L		26-FEB-07	CVM	R497347
Titanium (Ti)	0.002		0.001	mg/L		26-FEB-07	CVM	R497347
Thallium (Tl)	<0.05		0.05	mg/L		26-FEB-07	CVM	R497347
Vanadium (V)	0.001		0.001	mg/L		26-FEB-07	CVM	R497347
Zinc (Zn)	0.202		0.001	mg/L		26-FEB-07	CVM	R497347
Free CO2	<1		1	mg/L		23-FEB-07	HSC/GC	R496727
VOC Extended List								
1,1,1,2-Tetrachloroethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,1,2,2-Tetrachloroethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,1,1-Trichloroethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,1,2-Trichloroethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,1-Dichloroethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,1-Dichloroethylene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,1-Dichloropropene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2,3-Trichloropropane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2,3-Trichlorobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2,4-Trichlorobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2,4-Trimethylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2-Dibromo-3-chloropropane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2-Dibromoethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2-Dichlorobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2-Dichloroethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,2-Dichloropropane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,3,5-Trimethylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,3-Dichlorobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,3-Dichloropropane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
1,4-Dichlorobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
2,2-Dichloropropane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
2-Chloroethylvinyl Ether	<20		20	ug/L		26-FEB-07	SH	R497075
2-Chlorotoluene	<20		20	ug/L		26-FEB-07	SH	R497075
2-Hexanone	<20		20	ug/L		26-FEB-07	SH	R497075
4-Chlorotoluene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Acetone	<20		20	ug/L		26-FEB-07	SH	R497075
Benzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Bromobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Bromochloromethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Bromodichloromethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Bromoform	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Bromomethane	<1		1	ug/L		26-FEB-07	SH	R497075
Carbon Disulfide	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Carbon tetrachloride	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Chlorobenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Chloroethane	<1		1	ug/L		26-FEB-07	SH	R497075
Chloroform	<0.5		0.5	ug/L		26-FEB-07	SH	R497075

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L481117-6 H								
Sampled By: NOT PROVIDED on 22-FEB-07 @ 12:30								
Matrix: WATER								
VOC Extended List								
Chloromethane	<1		1	ug/L		26-FEB-07	SH	R497075
cis-1,2-Dichloroethylene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
cis-1,3-Dichloropropene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Dibromochloromethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Dibromomethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Dichlorodifluoromethane	<1		1	ug/L		26-FEB-07	SH	R497075
Dichloromethane	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Ethyl Benzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Hexachlorobutadiene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Isopropylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Isopropyltoluene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
m+p-Xylenes	<1		1	ug/L		26-FEB-07	SH	R497075
Methyl Ethyl Ketone	<20		20	ug/L		26-FEB-07	SH	R497075
Methyl Isobutyl Ketone	<20		20	ug/L		26-FEB-07	SH	R497075
MTBE	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Naphthalene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
n-Butylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
n-Propylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
o-Xylene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
sec-Butylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Styrene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
tert-Butylbenzene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Tetrachloroethylene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Toluene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
trans-1,2-Dichloroethylene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
trans-1,3-Dichloropropene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Trichloroethylene	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Trichlorofluoromethane	<1		1	ug/L		26-FEB-07	SH	R497075
Vinyl chloride	<0.5		0.5	ug/L		26-FEB-07	SH	R497075
Trihalomethanes (total)	<2.0		2	ug/L		26-FEB-07	SH	R497075
Xylenes (Total)	<1.5		1.5	ug/L		26-FEB-07	SH	R497075
Surr: 1,2-Dichloroethane d4	108		51-150	%		26-FEB-07	SH	R497075
Surr: Toluene-d8	100		72-123	%		26-FEB-07	SH	R497075
Surr: 4-Bromofluorobenzene	104		50-150	%		26-FEB-07	SH	R497075
Major Ions & Extractable Metals								
Chloride (Cl)	237		0.1	mg/L		26-FEB-07	MAT	R497460
Extractable Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		27-FEB-07	CVM	R497077
Aluminum (Al)	0.10		0.01	mg/L		27-FEB-07	CVM	R497077
Boron (B)	0.36		0.05	mg/L		27-FEB-07	CVM	R497077
Barium (Ba)	0.137		0.003	mg/L		27-FEB-07	CVM	R497077
Beryllium (Be)	<0.001		0.001	mg/L		27-FEB-07	CVM	R497077
Cadmium (Cd)	<0.001		0.001	mg/L		27-FEB-07	CVM	R497077
Cobalt (Co)	<0.002		0.002	mg/L		27-FEB-07	CVM	R497077
Chromium (Cr)	0.007		0.005	mg/L		27-FEB-07	CVM	R497077
Copper (Cu)	0.027		0.001	mg/L		27-FEB-07	CVM	R497077
Molybdenum (Mo)	<0.005		0.005	mg/L		27-FEB-07	CVM	R497077
Nickel (Ni)	<0.002		0.002	mg/L		27-FEB-07	CVM	R497077
Lead (Pb)	0.158		0.005	mg/L		27-FEB-07	CVM	R497077
Tin (Sn)	<0.05		0.05	mg/L		27-FEB-07	CVM	R497077
Strontium (Sr)	0.104		0.005	mg/L		27-FEB-07	CVM	R497077

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L481117-6 H								
Sampled By: NOT PROVIDED on 22-FEB-07 @ 12:30								
Matrix: WATER								
Major Ions & Extractable Metals								
Extractable Trace Metals								
Titanium (Ti)	0.005		0.001	mg/L		27-FEB-07	CVM	R497077
Thallium (Tl)	<0.05		0.05	mg/L		27-FEB-07	CVM	R497077
Vanadium (V)	0.002		0.001	mg/L		27-FEB-07	CVM	R497077
Zinc (Zn)	0.108		0.001	mg/L		27-FEB-07	CVM	R497077
ICP metals for routine water								
Calcium (Ca)	2.2		0.5	mg/L		26-FEB-07	JF	R496944
Potassium (K)	1.8		0.1	mg/L		26-FEB-07	JF	R496944
Magnesium (Mg)	0.3		0.1	mg/L		26-FEB-07	JF	R496944
Sodium (Na)	486		1	mg/L		26-FEB-07	JF	R496944
Ion Balance Calculation								
Ion Balance	105			%		27-FEB-07		
TDS (Calculated)	1140			mg/L		27-FEB-07		
Hardness (as CaCO3)	7			mg/L		27-FEB-07		
Iron (Fe)-Extractable	0.333		0.005	mg/L		27-FEB-07	HAS	R497497
Manganese (Mn)-Extractable	0.011		0.001	mg/L		27-FEB-07	HAS	R497497
Nitrate and Nitrite as N	<0.07		0.07	mg/L		27-FEB-07		
Nitrate-N	0.07		0.05	mg/L		26-FEB-07	MAT	R497460
Nitrite-N	<0.05		0.05	mg/L		26-FEB-07	MAT	R497460
Sulphate (SO4)	1.2		0.5	mg/L		26-FEB-07	MAT	R497460
pH, Conductivity and Total Alkalinity								
pH	7.8		0.1	pH		26-FEB-07	MAT	R497161
Conductivity (EC)	1930		3	uS/cm		26-FEB-07	MAT	R497161
Bicarbonate (HCO3)	828		5	mg/L		26-FEB-07	MAT	R497161
Carbonate (CO3)	<5		5	mg/L		26-FEB-07	MAT	R497161
Hydroxide (OH)	<5		5	mg/L		26-FEB-07	MAT	R497161
Alkalinity, Total (as CaCO3)	679		5	mg/L		26-FEB-07	MAT	R497161
Total & Fecal Coliform Count-MF								
MF - Fecal Coliforms	<1		1	CFU/100mL	24-FEB-07	25-FEB-07	BJS	R496679
MF - Total Coliforms	10		1	CFU/100mL	24-FEB-07	25-FEB-07	BJS	R496679

ALBERTA RESEARCH COUNCIL | ORGANICS ANALYSIS DATA SHEET | ARC SAMPLE NUMBER: T07-1615

VOLATILE PRIORITY POLLUTANTS

Contact: Miller
SmpNo : 07MU080998 ProjNo : GrpSmpNo :
StaNo : AB05CE1470 StaType: Ground Water
Comment: Redland
Matrix : 6
SmpDate: 4-Jun-07 @ 1600 Samplers..ID1 : 195635
EndDate: @ ..ID2 :

METHOD: A102.1
SCAN: VPP

TimeLines (days)	from sample date	Max	Actual
Date Received : 6-Jun-07 by: GP		-	2 --
Date Extracted: 12-Jun-07 by: SS		7	8 *
Date Analyzed : 12-Jun-07 by: BJS		7	8 *

Raw DataFile : V1615

VMV_CODE	COMPOUND NAME	ug/L	flag	MDL	+\-
100651	1,1,1,2-Tetrachloroethane	0.0		.1	.1
95224	1,1,2,2-Tetrachloroethane	0.0		.1	.1
95214	1,1-Dichloroethane	0.0		.1	.1
100645	1,1-Dichloropropylene	0.0		.1	.1
100655	1,2,3-Trichloropropane	0.0		.1	.1
100656	1,2,4-Trimethylbenzene	0.0		.1	.1
100641	1,2-Dibromoethane	0.0		.1	.1
95215	1,2-Dichloroethane	0.0		.1	.1
100657	1,3,5-Trimethylbenzene	0.0		.1	.1
100644	1,3-Dichloropropane	0.0		.1	.1
100643	2,2-Dichloropropane	0.0		.1	.1
100638	2-Chlorotoluene	0.0		.1	.1
95200	Benzene	0.0		.1	.1
95201	Bromodichloromethane	0.0		.1	.1
95203	Bromomethane	0.0		.1	.1
95205	Chlorobenzene	0.0		.1	.1
95208	Chloroform	0.0		.1	.1
95209	Dibromochloromethane	0.0		.1	.1
95221	Ethyl benzene	0.0		.1	.1
100647	Isopropylbenzene	0.0		.1	.1
95222	Methylene chloride	0.0		2.0	.1
95223	Styrene	0.0		.1	.1
95225	Tetrachloroethylene	0.0		.3	.1
100654	Trichloroethylene	0.0		.1	.1
95232	Vinyl chloride	0.0		.5	.1
100642	cis-1,2-Dichloroethylene	0.0		.1	.1
95234	m,p-Xylene	0.0		.1	.1
100650	n-Propylbenzene	0.0		.1	.1
100648	p-Isopropyltoluene	0.0		.1	.1
100636	tert-Butylbenzene	0.0		.1	.1
95220	trans-1,3-Dichloropropylene	0.0		.3	.1
95227	1,1,1-Trichloroethane	0.0		.1	.
95228	1,1,2-Trichloroethane	0.0		.1	.
95216	1,1-Dichloroethylene	0.0		.1	.
100652	1,2,3-Trichlorobenzene	0.0		.1	.
100653	1,2,4-Trichlorobenzene	0.0		.1	.
100640	1,2-Dibromo-3-chloropropane	0.0		.3	.
95211	1,2-Dichlorobenzene	0.0		.1	.
95218	1,2-Dichloropropane	0.0		.1	.
95212	1,3-Dichlorobenzene	0.0		.1	.
95213	1,4-Dichlorobenzene	0.0		.1	.
95207	2-Chloroethoxyethylene	0.0		.4	.
100639	4-Chlorotoluene	0.0		.1	.
100634	Bromobenzene	0.0		.1	.
95202	Bromoform	0.0		.5	.
95204	Carbon tetrachloride	0.0		.1	.
95206	Chloroethane	0.0		.1	.
106204	Chloromethane	0.0		.5	.
95210	Dibromomethane	0.0		.1	.
100646	Hexachlorobutadiene	0.0		.3	.
102608	MTBE	0.0		.1	.
100649	Naphthalene	0.0		.1	.
100397	TRIHALOMETHANES	0.0		.1	.
95226	Toluene	0.0		.1	.
95229	Trichlorofluoromethane	0.0		.1	.
100407	XYLENES	0.0		.1	.
95219	cis-1,3-Dichloropropylene	0.0		.3	.
100637	n-Butylbenzene	0.0		.1	.
95233	o-Xylene	0.0		.1	.
100635	sec-Butylbenzene	0.0		.1	.
95217	trans-1,2-Dichloroethylene	0.0		.1	.

Zero (0) values indicate that the analyte is not DETECTED. MDL - Method Detection Limit

flags B - This analyte is found in the blank as well as the sample. The blank value has been subtracted.
X - Estimated value. The target compound meets the identification criteria, but is less than the MDL.
H - Compound Detected Q - Qualifying ions present but failed the ion ratio limits.
M - This value is calculated by an alternate Raw DataFile.

* - asterik following the value for Actual days taken indicates the prescribed time for that event was exceeded.

** - the Date Sampled is unknown, therefore timeline calculations can not be performed.

Certified For: Yogesh Kumar
Date: 15-Jun-07
Contact Person: Grant Prill

BUSINESS UNIT MANAGER
ANALYTICAL CHEMISTRY
ALBERTA RESEARCH COUNCIL
BAG 4000, VEGREVILLE, ALBERTA
T9C 1T4 (780) 632-8455

mail to: Miller Leslie
Alberta Environment
2nd Floor Deerfoot Square
2938-11st NE
Calgary, Alberta T2E 7L7

Contact: Miller
SmpNo : 07MU080998 ProjNo : GrpSmpNo :
StaNo : AB05CE1470 StaType: Ground Water
Comment: Redland
Matrix : 6
SmpDate: 4-Jun-07 @ 1600 Samplers..ID1 : 195635
EndDate: @ ..ID2 :

VOLATILE PRIORITY POLLUTANTS
METHOD: A102.1 | TimeLines (da
SCAN: VPP | from sample d

		Max	Actu
Date Received :	6-Jun-07 by: GP	-	2
Date Extracted:	12-Jun-07 by: SS	7	8
Date Analyzed :	12-Jun-07 by: BJS	7	8

Raw DataFile : V1615

TENTATIVELY IDENTIFIED COMPOUNDS // COMMENTS	ESTIMATED CONCENTRATION ug/L
2-Propanol, 2-Methyl	1.0

Laboratory's comments regarding this sample:

The following items regarding the sample were recorded. A Yes notation indicates a problem with the specified item.

Inappropriate Sample Container - No
Inappropriate Temperature - No
Inappropriate Headspace - No
Broken / Leaking Container - No

This sample was analyzed by GC/MS. An additional GC/FID scan may have been used for screening purposes and to assist with quantitative data analysis.
Estimated concentrations for tentively identified compounds are calculated assuming an equal response to internal standards.
* - asterik following the value for Actual days taken indicates the prescribed time for that event was exceeded.
** - the Date Sampled is unknown, therefore timeline calculations can not be performed.

Certified For: Yogesh Kumar
Date: 15-Jun-07
Contact Person: Grant Prill

BUSINESS UNIT MANAGER
ANALYTICAL CHEMISTRY
ALBERTA RESEARCH COUNCIL
BAG 4000, VEGREVILLE, ALBERTA
T9C 1T4 (780) 632-8455

mail to: Miller Leslie
Alberta Environment
2nd Floor Deerfoot Square
2938-11st NE
Calgary, Alberta T2E 7L7

If there are any questions or concerns regarding this report, please contact the person indicated above.
Please check the mailing information and inform the lab if changes are required.

Contact: Miller
SmpNo : 07MU080998 ProjNo : GrpSmpNo :
StaNo : AB05CE1470 StaType: Ground Water
Comment: Redland
Matrix : 6
SmpDate: 4-Jun-07 @ 1600 Samplers..ID1 : 195635
EndDate: @ ..ID2 :

EXTRACTABLE PRIORITY POLLUTANTS
METHOD: EC/3
SCAN: EPP

	TimeLines (days) from sample date	
	Max	Actual
Date Received : 6-Jun-07 by: GP	-	2 --
Date Extracted: 11-Jun-07 by: drc	7	7 ok
Date Analyzed : 12-Jun-07 by: drc	21	8 ok

Raw DataFile : E1616

VMV_CODE	COMPOUND NAME	ug/L	flag	MDL	+\-
100730	1,2,4-Trichlorobenzene	0.0		.1	.1
103632	2,3,4,6-Tetrachlorophenol	0.0		.1	.2
100700	2,4-Dichlorophenol	0.0		.1	.2
100703	2,4-Dinitrophenol	0.0		.1	.2
100733	2,6-Dinitrotoluene	0.0		.1	.1
100699	2-Chlorophenol	0.0		.2	.2
100704	2-Nitrophenol	0.0		.1	.2
100698	4-Chloro-3-methylphenol	0.0		.1	.2
100705	4-Nitrophenol	0.0		.1	.2
100710	Acenaphthylene	0.0		.1	.1
100731	Benzidine	0.0		.2	.2
100716	Benzo(a)pyrene	0.0		.1	.2
100715	Benzo(ghi)perylene	0.0		.2	.1
100739	Bis(2-chloroethoxy)methane	0.0		.1	.1
100741	Bis(2-chloroisopropyl)ether	0.0		.1	.1
100743	Butylbenzylphthalate	0.0		.1	.1
100744	Di-n-butylphthalate	0.0		.1	.1
100718	Dibenzo(ah)anthracene	0.0		.5	.1
100746	Dimethyl phthalate	0.0		.1	.1
100720	Fluorene	0.0		.1	.1
100727	Hexachlorobutadiene	0.0		.5	.1
100729	Hexachloroethane	0.0		.5	.1
100749	Isophorone	0.0		.1	.1
100736	N-Nitrosodiphenylamine	0.0		.1	.1
100735	Nitrobenzene	0.0		.1	.1
100723	Phenanthrene	0.0		.1	.1
100724	Pyrene	0.0		.1	.1

VMV_CODE	COMPOUND NAME	ug/L	flag	MDL	+\-
100734	1,2-Diphenylhydrazine	0.0		.1	.1
100708	2,4,6-Trichlorophenol	0.0		.1	.2
100701	2,4-Dimethylphenol	0.0		.2	.2
100732	2,4-Dinitrotoluene	0.0		.1	.1
100725	2-Chloronaphthalene	0.0		.1	.1
100702	2-Methyl-4,6-dinitrophenol	0.0		.1	.2
100738	4-Bromophenyl phenyl ether	0.0		.1	.1
100742	4-Chlorophenyl phenyl ether	0.0		.1	.1
100709	Acenaphthene	0.0		.1	.1
100711	Anthracene	0.0		.1	.1
100712	Benzo(a)anthracene	0.0		.1	.1
100713	Benzo(b)fluoranthene	0.0		.1	.1
100714	Benzo(k)fluoranthene	0.0		.1	.1
100740	Bis(2-chloroethyl)ether	0.0		.1	.1
100748	Bis(2-ethylhexyl)phthalate	0.0		.1	.1
100717	Chrysene	0.0		.1	.1
100747	Di-n-octyl phthalate	0.0		.1	.1
100745	Diethyl phthalate	0.0		.1	.1
100719	Fluoranthene	0.0		.1	.1
100726	Hexachlorobenzene	0.0		.1	.1
100728	Hexachlorocyclopentadiene	0.0		.1	.1
100721	Indeno(1,2,3-cd)pyrene	0.0		.1	.1
100737	N-Nitroso-di-n-propylamine	0.0		.2	.1
100722	Naphthalene	0.0		.1	.1
100706	Pentachlorophenol	0.0		.1	.2
100707	Phenol	0.0		.1	.2

Zero (0) values indicate that the analyte is not DETECTED. MDL - Method Detection Limit

flags B - This analyte is found in the blank as well as the sample. The blank value has been subtracted.
X - Estimated value. The target compound meets the identification criteria, but is less than the MDL.
H - Compound Detected Q - Qualifying ions present but failed the ion ratio limits.
M - This value is calculated by an alternate Raw DataFile.

* - asterik following the value for Actual days taken indicates the prescribed time for that event was exceeded.

** - the Date Sampled is unknown, therefore timeline calculations can not be performed.

Certified For: Yogesh Kumar
Date: 13-Jun-07
Contact Person: Grant Prill

BUSINESS UNIT MANAGER
ANALYTICAL CHEMISTRY
ALBERTA RESEARCH COUNCIL
BAG 4000, VEGREVILLE, ALBERTA
T9C 1T4 (780) 632-8455

mail to: Miller Leslie
Alberta Environment
2nd Floor Deerfoot Square
2938-11st NE
Calgary, Alberta T2E 7L7

If there are any questions or concerns regarding this report, please contact the person indicated above.
Please check the mailing information and inform the lab if changes are required.

ALBERTA RESEARCH COUNCIL | ORGANICS ANALYSIS DATA SHEET | ARC SAMPLE NUMBER: T07-1617

Contact: Miller
SmpNo : 07MU080998 ProjNo : GrpSmpNo :
StaNo : AB05CE1470 StaType: Ground Water
Comment: Redland
Matrix : 6
SmpDate: 4-Jun-07 @ 1600 Samplers..ID1 : 195635
EndDate: @ ..ID2 :

CCME Hydrocarbons in Water
METHOD: 3319
SCAN: F123W

		TimeLines (days)	
		from sample date	
		Max	Actual
Date Received : 6-Jun-07	by: GP	-	2
Date Extracted: 12-Jun-07	by: SS	10	8 ok
Date Analyzed : 12-Jun-07	by: BJS	14	8 ok
Raw DataFile : V1617			

DataFile	Analyzed	VMV_CODE	COMPOUND NAME	ug/L	flag	MDL	+\-
V1617	12-Jun-07	106092	F1 Benzene	0.0		.1	
V1617	12-Jun-07	106094	F1 Ethylbenzene	0.0		.1	
V1617	12-Jun-07	106091	F1 Hydrocarbons(C6-C10)-BTEX	0.0		10.0	
V1617	12-Jun-07	106093	F1 Toluene	0.0		.1	
V1617	12-Jun-07	106095	F1 m,p-Xylene	0.0		.1	
V1617	12-Jun-07	106096	F1 o-Xylene	0.0		.1	
E1617	13-Jun-07	106097	F2 Hydrocarbons(C10-C16)	0.0		5.0	
E1617	13-Jun-07	106098	F3 Hydrocarbons(C16-C34)	0.0		20.0	
E1617	13-Jun-07		F4 Hydrocarbons(C34-C50)	0.0		20.0	

Zero (0) values indicate that the analyte is not DETECTED. MDL - Method Detection Limit

flags B - This analyte is found in the blank as well as the sample. The blank value has been subtracted.
X - Estimated value. The target compound meets the identification criteria, but is less than the MDL.
H - Compound Detected Q - Qualifying ions present but failed the ion ratio limits.
M - This value is calculated by an alternate Raw DataFile.

* - asterik following the value for Actual days taken indicates the prescribed time for that event was exceeded.

** - the Date Sampled is unknown, therefore timeline calculations can not be performed.

Certified For: Yogesh Kumar
Date: 15-Jun-07
Contact Person: Grant Prill

BUSINESS UNIT MANAGER
ANALYTICAL CHEMISTRY
ALBERTA RESEARCH COUNCIL
BAG 4000, VEGREVILLE, ALBERTA
T9C 1T4 (780) 632-8455

mail to: Miller Leslie
Alberta Environment
2nd Floor Deerfoot Square
2938-11st NE
Calgary, Alberta T2E 7L7

Client: Miller

Sample No: 07MU080998 Group Sample No: Site Descrip/Comment: Redland

Station No: AB05CE1470 Project No: Canister:

Agency: 202 Samp Type: 1 SampMatrix: 6 Collection: 1 Samp Date: 4-Jun-07 Time: 1600 Samplers ID: 195635

SubGroups	FILE	VMV	NAME	ConcRpt	MDL	ConcRptUnit	InjDate
DG_C1C4							
	W1618	106770	Butane	0.00	.01	ug/L	11-Jun-07
	W1618	106771	Ethane	3.10	.01	ug/L	11-Jun-07
	W1618	106772	Ethylene	0.00	.01	ug/L	11-Jun-07
	W1618	106773	Isobutane	0.00	.01	ug/L	11-Jun-07
	W1618	106774	Methane	26200.00	.01	ug/L	11-Jun-07
	W1618	106775	Propane	0.00	.01	ug/L	11-Jun-07
DG_TCD							
	L1618	106776	Carbon dioxide	402.00	1.00	mg/L	12-Jun-07
	L1618	106777	Nitrogen	11.30	6.00	mg/L	12-Jun-07
	L1618		Oxygen	4.34	6.00	mg/L	12-Jun-07
G_C1C4							
	C1618	106778	Butane	0.00	.05	ppmv	11-Jun-07
	C1618	106779	Ethane	28.80	.05	ppmv	11-Jun-07
	C1618	106780	Ethylene	0.00	.05	ppmv	11-Jun-07
	C1618	106781	Isobutane	0.00	.05	ppmv	11-Jun-07
	C1618	106782	Methane	847000.00	.05	ppmv	11-Jun-07
	C1618	106783	Propane	0.00	.05	ppmv	11-Jun-07
G_TCD							
	G1618	106784	Carbon dioxide	1940.00	300.00	ppmv	11-Jun-07
	G1618	106785	Nitrogen	210000.00	1000.00	ppmv	11-Jun-07
	G1618		Oxygen	39600.00	1000.00	ppmv	11-Jun-07

[ARC_Remarks]:

SubGroups

DG_C1C4 and DG_TCD - Disolved Gas in water sample

G_C1C4 and G_TCD - Free Gas from canister

Certified For: Yogesh Kumar, Business Unit Manager
Environmental Monitoring
By: Alberta Research Council
Vegreville, Alberta
T9C 1T4

Date: 14-Jun-07

Contact Person: Grant Prill
Environmental Monitoring
Alberta Research Council
Vegreville, Alberta T9C 1T4
T9C 1T4
(780) 632-8455

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L513388-1 RAW WATER-SIGNER WELL								
Sampled By: HVBL on 04-JUN-07 @ 16:00								
Matrix: WATER								
Total Metals								
Total Major Metals								
Calcium (Ca)	3.7		0.5	mg/L		07-JUN-07	HAS	R532430
Potassium (K)	1.0		0.1	mg/L		07-JUN-07	HAS	R532430
Magnesium (Mg)	0.4		0.1	mg/L		07-JUN-07	HAS	R532430
Sodium (Na)	451		1	mg/L		07-JUN-07	HAS	R532430
Iron (Fe)	0.061		0.005	mg/L		07-JUN-07	HAS	R532430
Manganese (Mn)	0.004		0.001	mg/L		07-JUN-07	HAS	R532430
Total Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		08-JUN-07	MX	R533081
Aluminum (Al)	0.07		0.01	mg/L		08-JUN-07	MX	R533081
Boron (B)	0.33		0.05	mg/L		08-JUN-07	MX	R533081
Barium (Ba)	0.143		0.003	mg/L		08-JUN-07	MX	R533081
Beryllium (Be)	<0.002		0.002	mg/L		08-JUN-07	MX	R533081
Cadmium (Cd)	<0.001		0.001	mg/L		08-JUN-07	MX	R533081
Cobalt (Co)	<0.002		0.002	mg/L		08-JUN-07	MX	R533081
Chromium (Cr)	0.008		0.005	mg/L		08-JUN-07	MX	R533081
Copper (Cu)	<0.001		0.001	mg/L		08-JUN-07	MX	R533081
Molybdenum (Mo)	<0.005		0.005	mg/L		08-JUN-07	MX	R533081
Nickel (Ni)	<0.002		0.002	mg/L		08-JUN-07	MX	R533081
Lead (Pb)	<0.005		0.005	mg/L		08-JUN-07	MX	R533081
Tin (Sn)	<0.05		0.05	mg/L		08-JUN-07	MX	R533081
Strontium (Sr)	0.092		0.002	mg/L		08-JUN-07	MX	R533081
Titanium (Ti)	0.003		0.001	mg/L		08-JUN-07	MX	R533081
Thallium (Tl)	<0.05		0.05	mg/L		08-JUN-07	MX	R533081
Vanadium (V)	0.002		0.001	mg/L		08-JUN-07	MX	R533081
Zinc (Zn)	0.003		0.001	mg/L		08-JUN-07	MX	R533081
Iron Bacteria	9000		25	CFU/mL		18-JUN-07	DJK	R536541
Methane, dissolved	110		0.005	mg/L	08-JUN-07	08-JUN-07	JDV	R532856
Sulfur Reducing Bacteria	<200		200	CFU/mL		15-JUN-07	RBD	R535886
TC and EC by MPN								
MPN - Total Coliforms	<1		1	MPN/100mL		06-JUN-07	DJK	R531591
MPN - E. coli	<1		1	MPN/100mL		06-JUN-07	DJK	R531591
Major Ions & Dissolved Metals								
Chloride (Cl)	264		0.1	mg/L		06-JUN-07	LHH	R532324
Dissolved Trace Metals								
Silver (Ag)	<0.005		0.005	mg/L		09-JUN-07	MX	R533071
Aluminum (Al)	<0.01		0.01	mg/L		09-JUN-07	MX	R533071
Boron (B)	0.31		0.05	mg/L		09-JUN-07	MX	R533071
Barium (Ba)	0.138		0.003	mg/L		09-JUN-07	MX	R533071
Beryllium (Be)	<0.001		0.001	mg/L		09-JUN-07	MX	R533071
Cadmium (Cd)	<0.001		0.001	mg/L		09-JUN-07	MX	R533071
Cobalt (Co)	<0.002		0.002	mg/L		09-JUN-07	MX	R533071
Chromium (Cr)	<0.005		0.005	mg/L		06-JUN-07	SYF	R531902
Copper (Cu)	<0.001		0.001	mg/L		09-JUN-07	MX	R533071
Molybdenum (Mo)	<0.005		0.005	mg/L		09-JUN-07	MX	R533071
Nickel (Ni)	<0.002		0.002	mg/L		09-JUN-07	MX	R533071
Lead (Pb)	<0.005		0.005	mg/L		09-JUN-07	MX	R533071
Tin (Sn)	<0.05		0.05	mg/L		09-JUN-07	MX	R533071
Strontium (Sr)	0.087		0.005	mg/L		09-JUN-07	MX	R533071
Titanium (Ti)	0.001		0.001	mg/L		09-JUN-07	MX	R533071

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L513388-1 RAW WATER-SIGNER WELL								
Sampled By: HVBL on 04-JUN-07 @ 16:00								
Matrix: WATER								
Major Ions & Dissolved Metals								
Dissolved Trace Metals								
Thallium (Tl)	<0.05		0.05	mg/L		09-JUN-07	MX	R533071
Vanadium (V)	0.004		0.001	mg/L		09-JUN-07	MX	R533071
Zinc (Zn)	0.004		0.001	mg/L		09-JUN-07	MX	R533071
ICP metals for routine water								
Calcium (Ca)	0.9		0.5	mg/L		11-JUN-07	JF	R533836
Potassium (K)	1.1		0.1	mg/L		11-JUN-07	JF	R533836
Magnesium (Mg)	<0.1		0.1	mg/L		11-JUN-07	JF	R533836
Sodium (Na)	514		1	mg/L		11-JUN-07	JF	R533836
Ion Balance Calculation								
Ion Balance	115	RRV		%		11-JUN-07		
TDS (Calculated)	1150			mg/L		11-JUN-07		
Hardness (as CaCO3)	2			mg/L		11-JUN-07		
Iron (Fe)-Dissolved	0.020		0.005	mg/L		06-JUN-07	SYF	R531902
Manganese (Mn)-Dissolved	0.003		0.001	mg/L		06-JUN-07	SYF	R531902
Nitrate and Nitrite as N	<0.07		0.07	mg/L		07-JUN-07		
Nitrate-N	<0.05		0.05	mg/L		06-JUN-07	LHH	R532324
Nitrite-N	<0.05		0.05	mg/L		06-JUN-07	LHH	R532324
Sulphate (SO4)	4.5		0.5	mg/L		06-JUN-07	LHH	R532324
pH, Conductivity and Total Alkalinity								
pH	8.5		0.1	pH		06-JUN-07	MAT	R532396
Conductivity (EC)	1870		3	uS/cm		06-JUN-07	MAT	R532396
Bicarbonate (HCO3)	704		5	mg/L		06-JUN-07	MAT	R532396
Carbonate (CO3)	15		5	mg/L		06-JUN-07	MAT	R532396
Hydroxide (OH)	<5		5	mg/L		06-JUN-07	MAT	R532396
Alkalinity, Total (as CaCO3)	602		5	mg/L		06-JUN-07	MAT	R532396

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L522182-1 RAW WATER SIGNER WELL Sampled By: CLIENT on 04-JUN-07 @ 16:00 Matrix: WATER								
Methane, dissolved	110		0.005	mg/L	26-JUN-07	26-JUN-07	CFR	R540243

* Refer to Referenced Information for Qualifiers (if any) and Methodology.