Sample	Latitude	Longitude	Depth (m bgs)	Type	Media	Major anions and alkalinity phase(lab)	Metals phase(lab)	Alcohols and VOCs phase(lab)	Low molecular weight acids, glycols phase(lab)	SVOCs Pesticides PCBs, TICs phase(lab)	GRO, DRO, THE, TPH phase(lab)	Bacteria phase(lab)	Fixed gases, C_1-C_6+, $\delta^{13}C$ and δD C_1-C_4 DOC DIC, $\delta^{13}C$ DIC $\delta^{18}O$ and δD water phase(lab)
PGDW06	43.27110813	-108.5599211	115.8	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW07	43.24678442	-108.6879085	154.2	PGP	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	I(R8^{5})
PGDW08	43.24697265	-108.6840567	157.0	PGP	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW09	43.27211644	-108.615144	9.1	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW10	43.23574855	-108.6563896	227.1	DW	water	I(R8^{1}) II(R8^{1})	I(K) II(A4)	I(L) II(A,R8^{2})	-----	I(L,R8^{3}) II(A,R8^{3})	I(E^{2}) II(E^{2},R8^{4})	II(E^{1})	I(R8^{5}) II(I^{1},R8^{5})
PGDW11	43.24312049	-108.6228628	227.1	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW12	43.27628927	-108.5661502	115.8	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW13	43.2444467	-108.6772771	------	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW14	43.25154027	-108.6273311	57.9	DW	water	I(R8^{1})	I(K)	I(L), IV(R8^{2},S^{4})	IV(S^{4},R3)	I(L,R8^{3})	-----	-----	IV(O^{4},S^{6})
PGDW15	43.24312129	-108.6671791	30.5	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW16	43.20381363	-108.6405183	161.5	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW17	43.20416653	-108.6368713	152.4	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	I(R8^{5})
PGDW18	43.22491388	-108.569651	67.1	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW19	43.21382469	-108.651274	19.8	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{4})	-----	-----	-----
PGDW20	43.25166961	-108.5912756	140.2	DW	water	I(R8^{1}) II(R8^{1}) III(O^{1}) IV(O^{1})	I(K), II(A4) III (S^{1}) IV(S^{1})	I(L) II(A,R8^{2}) III(R8^{2},S^{2}) IV(R8^{2},S^{3})	IV(S^{4},R3)	I(L,R8^{3}), II(A,R8^{3}) III(R8^{3}) IV(R8^{3})	I(E^{2}) II(E^{2},R8^{4}) III(R8^{4}) IV(R8^{4})	I(E^{1}) II(E^{1})	I(R8^{5}) II(R8^{5}) III(I^{2}, O^{2}, S^{5},S^{6}) IV(I^{2}, O^{2}, S^{2},S^{6})
PGDW21	43.25167095	-108.5912762	140.2	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	I(R8^{5})
PGDW22	43.24452934	-108.5981513	-------	DW	water	I(R8^{1}) II(R8^{1})	I(K) II(A4)	I(L) II(A,R8^{2})	-----	I(L,R8^{3}), II(A,R8^{3})	I(E^{2}) II(E^{2},R8^{4})	I(E^{1}) II(E^{1})	I(R8^{5}) II(R8^{5})
PGDW23	43.24866472	-108.6225943	152.4	DW	water	I(R8^{1}) II(R8^{1})	I(K) II(A4)	I(L), II(A,R8^{2}), IV(R8^{2},S^{3})	IV(S^{4},R3)	I(L,R8^{3}) II(A,R8^{3}) IV(R8^{3})	I(E^{2}) II(E^{2},R8^{4})	I(E^{1}) II(E^{1})	I(R8^{5}) II(I^{1},R8^{5}) IV(S^{6},S^{6})
PGDW24	43.25877211	-108.6015059	30.5	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW25	43.25558722	-108.5694867	243.8	DW	water	I(R8^{1}) II(R8^{1})	I(K), II(A4)	I(L), II(A,R8^{2})	-----	I(L,R8^{3}), II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGDW26	43.25512275	-108.6132115	19.8	DW	water	I(R8^{1}), IV(O^{1})	I(K)	I(L), IV(R8^{2}, S^{3})	IV(S^{4},R3)	I(L,R8^{3}) IV(R8^{3})	IV(R8^{4})	-----	I(R8^{5}) IV(I^{2}, O^{2}, O^{3},S^{6})
PGDW28	43.23993143	-108.6465688	25.9	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW29	43.21773909	-108.6288449	121.9	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	I(E^{2})	-----	I(R8^{5})

Sample	Latitude	Longitude	Depth (m bgs)	Type	Media	Major anions and alkalinity phase(lab)	Metals phase(lab)	Alcohols and VOCs phase(lab)	Low molecular weight acids, glycols phase(lab)	SVOCs Pesticides PCBs, TICs phase(lab)	GRO, DRO, THE, TPH phase(lab)	Bacteria phase(lab)	Fixed gases, C_1-C_6+, $\delta^{13}C$ and δD C_1-C_4 DOC DIC, $\delta^{13}C$ DIC $\delta^{18}O$ and δD water phase(lab)
PGDW30	43.25753218	-108.6225755	79.2	DW	water	I(R8^{1}) II(R8^{1}) III(O^{1}) IV(O^{1})	I(K), II(A4) III (S^{1}) IV(S^{1})	I(L) II(A,R8^{2}) III(R8^{2},S^{2}) IV(R8^{2},S^{3})	IV(S^{4},R3)	I(L,R8^{3}), II(A,R8^{3}) III(R8^{3}) IV(R8^{3})	II(E^{2}) III(R8^{4}) IV(R8^{4})	II(E^{1})	I(R8^{5}) II(R8^{5}) III(I^{2}, O^{2}, S^{5},S^{6}) IV(I^{2}, O^{2}, S^{5},S^{6})
PGDW31	43.27302485	-108.6615302	------	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW32	43.24075256	-108.5941561	205.7	DW	water	I(R8^{1}) II(R8^{1}) IV(O^{1})	I(K), II(A4), IV(S^{1})	I(L) II(A) IV(R8^{2},S^{3})	IV(S^{4},R3)	I(L,R8^{3}), II(A,R8^{3}) IV(R8^{3})	II(E^{2},R8^{4}) IV(R8^{4})	II(E^{1})	I(R8^{5}) II(R8^{5}) IV(I^{2}, O^{2}, O^{3},S^{6})
PGDW33	43.23855522	-108.5964146	9.1	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW34	43.23605297	-108.6058086	30.5	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	-----	-----	-----
PGDW35	43.23021564	-108.6241763	88.4	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})		-----	I(R8^{5})
PGDW36	43.25905726	-108.5987059	30.5	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	I(E^{2})	-----	-----
PGDW37	43.24016136	-108.6585376	24.4	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})		-----	-----
PGDW38	43.2296203	-108.572037	48.8	DW	water	I(R8^{1})	I(K)	I(L)	-----	I(L,R8^{3})	I(E^{2})	-----	I(R8^{5})
PGDW39	43.23750687	-108.5781708	6.1	DW	water	I(L) II(R8^{1})	I(L), II(A4)	I(L), II(A,R8^{2})	-----	I(L,R8^{3}), II(A,R8^{3})	-----	II(E^{1})	-----
PGDW40	43.26156616	-108.6198273	67.1	DW	water	II(R8)	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGDW41	43.262146	-108.6378479	114.6	DW	water	II(R8), IV(O^{1})	II(A4) IV(S^{1})	II(A,R8^{2}) IV(R8^{2},S^{3})	IV(S^{4},R3)	II(A,R8^{3}) IV(R8^{3})	II(E^{2},R8^{4}), IV(R8^{4})	II(E^{1})	II(I^{1},R8^{5}) IV(I^{2},S^{5},S^{6})
PGDW42	43.25574493	-108.647316	61.0	DW	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGDW43	43.25749207	-108.64151	------	DW	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGDW44	43.25086975	-108.6261292	228.6	DW	water	II(R8)	II(A4)	II(A,R8^{2}), IV(R8^{2},S^{3})	IV(S^{4},R3)	II(A,R8^{3}), IV(R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(R8^{5}) IV(I^{2},O^{3},S^{6})
PGDW45	43.25888062	-108.6130142	------	DW	water	II(R8), IV(O^{1})	II(A4) IV(S^{1})	II(A,R8^{2}) IV(R8^{2},S^{3})	IV(S^{4},R3)	II(A,R8^{3}) IV(R8^{3})	II(E^{2},R8^{4}), IV(R8^{4})	II(E^{1})	II(R8^{5}) IV(I^{2},O^{2},O^{3},S^{6})
PGDW46	43.24651337	-108.6157684	14.6	DW	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGDW47	43.24520493	-108.6319885	147.5	DW	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGDW48	43.2299881	-108.6235733	------	DW	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(R8^{5})
PGDW49	43.25505829	-108.6178741	------	DW	water	II(R8^{1})	II(A4)	II(A,R8^{2}) IV(R8^{2},S^{3})	-----	II(A,R8^{3}) IV(R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(R8^{5}) IV(I^{2},O^{3},S^{6})
PGPW01	43.24678802	-108.6879349	~ 154	PGP	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
PGPW02	43.24697113	-108.6840515	~ 154	PGP	water	II(R8^{1})	II(A4)	II(A,R8^{2})	-----	II(A,R8^{3})	II(E^{2},R8^{4})	II(E^{1})	II(I^{1},R8^{5})
LD-02	43.25167095	-108.5912762	185.9	DW	water	III(O^{1})	III(S^{1})	III(S^{2})	-----	III(R8^{3})	-----	-----	III(I^{2},O^{2}, S^{5},S^{6})

Laboratories, Analytes, and Methods

A - ALS Laboratory Group, Salt Lake City, UT. VOCs, SVOCs, pesticides, TCBs, TICs determined using methods specified under the CLP.

A4 - A4 Scientific, The Woodlands, TX. TAL metals determined using methods specified under the CLP.

E[1] - Energy Laboratories Inc., Billings, MT. Heterotrophic plate counts, iron reducing bacteria, sulfur reducing bacteria.

E[2] - Energy Laboratories Inc., Billings, MT. GRO, DRO, THE, and TPH.

I[1] - Isotech Laboratories, Champaign, IL under contract by EnCana. Fixed gases and light hydrocarbons determined using ASTM D1945-03 in gas samples and headspace of aqueous samples. $\delta^{13}C$ and δD for C_1 determined using gas stripping and IRMS in aqueous samples. $\delta^{13}C$ and δD for C_1-C_4 determined using IRMS for gas samples.

I[2] - Isotech Laboratories, Champaign, IL. Fixed gases and light hydrocarbons determined using ASTM D1945-03 in headspace of aqueous samples. $\delta^{13}C$ and δD for C_1 and $\delta^{13}C$ for C_2 and C_3 determined using gas stripping and IRMS in aqueous samples. $\delta^{13}C$ DIC using gas stripping and IRMS.

I[3] - Isotech Laboratories, Champaign, IL. Fixed gases and light hydrocarbons determined using ASTM D1945-03 in headspace of aqueous samples. $\delta^{13}C$ and δD for C_1 , $\delta^{13}C$ for C_2 - C_5, and $\delta^{13}C$ for DIC gas stripping and IRMS in aqueous samples.

I[4] - Isotech Laboratories, Champaign, IL. Fixed gases and light hydrocarbons determined using ASTM D1945-03 in gas samples. $\delta^{13}C$ and δD for C_1 - C_3 using IRMS in gas samples.

I[5] - Isotech Laboratories, Champaign, IL. Fixed gases and light hydrocarbons determined using ASTM D1945-03 in gas samples. $\delta^{13}C$ and δD for C_1 - C_3 using IRMS in gas samples. ^{14}C using AMS in gas samples.

K - KAP Laboratories, Vancouver, WA. TAL metals determined under the CLP.

L - Liberty Analytical, Salt Lake City, UT. VOCs, SVOCs, PCBs, and TICs determined under the CLP.

O[1] - EPA, ORD, Ada, OK. SO_4, Cl, F, and Br determined using RSKSOP 276v3 and EPA Method 6500. NO_3 + NO_2 and NH_4 determined using RSKSOP 214v5 and EPA Method 350.1 and 353.2

O[2] - EPA, ORD, Ada, OK. DIC and DOC determined using RSKSOP-330v0 and EPA Method 9060A.

O[3] - EPA, ORD, Ada, OK. C_1 determined using RSKSOP 175v5 and Cali-5 gas sampling bags.

R3 - U.S. EPA Region 3 Laboratory, Fort Mead, MD. Diethylene glycol, triethylene glycol, tetraethylene glycol, and 2-butoxyethanol analysis by LC/MS/MS. This method is under development with no finalized SOP. EPA Methods 8000C and 8321 were followed for method development and QA/QC limits where applicable.

R8[1] - U.S. EPA Region 8 Laboratory, Golden, CO (fluoride, chloride, nitrite-N, nitrate-N, orthophosphate-P, and sulfate determined using EPA Method 300.0 and EPA Region SOP 310. Alkalinity determined using EPA Method 310.0).

R8[2] - U.S. EPA Region 8 Laboratory, Golden, CO. VOCs determined using EPA Method 8260B.

R8[3] - U.S. EPA Region 8 Laboratory, Golden, CO. SVOCs determined using ORGM-515 r1.1 and EPA Method 8270D.

R8[4] - U.S. EPA Region 8 Laboratory, Golden, CO. GRO determined using ORGM-506 r1.0 and EPA Method 8015D. DRO determined using ORGM-508 r1.0 and EPA Method 8015D.

R8[5] - U.S. EPA Region 8 Laboratory, Golden, CO. Dissolved C_1 in Phase I and dissolved C_1-C_3 in Phase II using EPA Method 524.2.

S[1] - Shaw Inc, Ada, OK in Phases III and IV. Metals and metals speciation determined using RSKSOP 213v4 and 257v2, or 332V0 and EPA Methods 200.7 and 6020.

S[2] - Shaw Inc, Ada, OK in Phases III and IV. Aromatics and chlorinated hydrocarbons determined using method RSKSOP-259v1 and EPA Method 5021A plus 8260C.

S[3] - Shaw Inc, Ada, OK . Alcohols, aromatics, and chlorinated hydrocarbons determined using method RSKSOP-259v1.

S[4] - Shaw Inc, Ada, OK. Low molecular weight acids determined using RSKSOP-112v6.

S[5] - Shaw Inc, Ada, OK. Dissolved gases C_1-C_4 determined using RSKSOP 194v4 and 175v5.

S[6] - Shaw Inc, Ada, OK. Hydrogen and oxygen isotope ratios of water determined using RSKSOP-296v0.

Abbreviations

I () - Phase I(laboratory/method). Samples collected March, 2009
II() - Phase II(laboratory/method). Samples collected January, 2010
III() - Phase III(laboratory/method). Samples collected September and October 2010
IV() - Phase IV(laboratory/method). Samples collected April 2011.
PG - gas production well
MW - deep monitoring wells
PGM - shallow monitoring wells near pits
PGS - soil samples near pits
DW - domestic wells
PGP - municipal wells in the Town of Pavillion
IRMS - isotope-ratio mass spectrometry
AMS - accelerated mass spectrometry
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenyls
TICs - tentatively identified compounds
DRO - diesel range organics
GRO - gasoline range organics
TEH - total extractable hydrocarbons
TPH - total purgeable hydrocarbons
DIC - dissolved inorganic carbon
TAL - target analyte list
CLP - U.S. EPA Contract Laboratory Program
C_1 (methane), C_2 (ethane), C_3 (propane), iC_4 (isobutane), nC_4 (normal butane), iC_5 (isopentane), nC_5 (normal pentane), C_6^+ (hexanes + other light hydrocarbons)

Analytical Methods

ORGM-506 r1.0 - Region 8 Standard Operating Procedure.

ORGM-508 r1.0 - Region 8 Standard Operating Procedure.

ORGM-515 r1.1 - Region 8 Standard Operating Procedure.

RSKSOP-112v6 – Standard Operating Procedure for Quantitative Analysis of Low Molecular Weight Acids in Aqueous Samples by HPLC, 22 p.

RSKSOP-175v5 - Sample Preparation and Calculations for Dissolved Gas Analysis in Water Samples Using a GC Headspace Equilibration Technique, 16 p.

RSKSOP-194v4 - Gas Analysis by Micro Gas Chromatographs (Agilent MIcro 3000), 13 p.

RSKSOP-213v4 - Standard operating procedure for operation of Perkin Elmer Optima 3300 DV ICP-OES, 21 p.

RSKSOP-214v5 - Quality control procedures for general parameters analysis using Lachat Flow Injection analysis (FIA), 10 p.

RSKSOP-259v1 - Determination of volatile organic compounds (fuel oxygenates, aromatic and chlorinated hydrocarbons) in water using automated headspace gas chromatography/mass spectrometry TEKMAR 7000 HS-Varian 2100T GC/MS system-ION trap detector, 28 p.

RSKSOP-257v2 - Standard operating procedure for elemental analysis by ICP-MS, 16 p.

RSKSOP-299v1 – Determination of Volatile Organic Compounds (Fuel Oxygenates, Aromatic and Chlorinated Hydrocarbons) in Water Using Automated Headspace Gas Chromatography/Mass Spectrometry (Agilent 6890/5973 Quadruple GC/MS System), 25 p.

RSKSOP-276v3 - Determination of major anions in aqueous samples using capillary ion electrophoresis with indirect UV detection and Empower 2 software, 11 p.

RSKSOP-296v0 - Determination of hydrogen and oxygen isotope ratios in water samples using high temperature conversion elemental analyzer (TC/EA), a continuous flow unit, and an isotope ratio mass spectrometer (IRMS), 8 p.

RSKSOP-297v1 – Metals Speciation Determination by LC/ICP-MS, 21 p.

RSKSOP-298v1 - Arsenic Speciation Determination by LC/ICP-MS with Anion Suppression and NaOH Mobile Phase, 21 p.

RSKSOP-313v1 - Determination of R-123 using the H25-IR Infrared Refrigerant Gas Leak Detector, 12 p.

RSKSOP-314v1 - Determination of Fixed Gases using the GEM2000 and GEM2000 Plus Gas Analyzers & Extraction Monitors, 13 p.

RSKSOP-320v1 - Determination of Organic and Inorganic Vapors Using the TVA-1000B Toxic Vapor Analyzer, 18 p.

RSKSOP-330v0 – Determination of Various Fractions of Carbon in Aqueous Samples Using the Shimadzu TOC-VCPH Analyzer, 16 p.

U.S. EPA Method 200.7 - Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Spectrometry, Rev. 5, Jan 2001.

U.S. EPA Method 300.0 - Determination of Inorganic Anions by Ion Chromatography, Rev. 2.1, Aug. 1993.
.
U.S. EPA method 310.1 - Alkalinity (Titrimetric, pH 4.5), Rev. 1978.

U.S. EPA Method 350.1 - Determination of Ammonia Nitrogen by Semi-Automated Colorimetry, Rev. 2, Aug. 1993.

U.S. EPA Method 5021A - Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis, Rev. 1, June 2003.

U.S. EPA Method 6020 - Inductively Coupled Plasma-Mass Spectrometry, Rev. 1, Feb. 2007.

U.S. EPA Method 6500 - Dissolved Inorganic Anions in Aqueous Matrices by Capillary Electrophoresis, Rev. 0, Feb. 2007.

U.S. EPA Method 8260C - Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Rev. 3, Aug. 2006.

U.S. EPA Method 8015B - Determination of Nonhalogenated Organics Using GC/FID, Rev. 2, Dec. 1996.

U.S. EPA Method 8015D - Nonhalogenated Organics Using GC/FID, Rev. 4, May 2003.

U.S. EPA Method 8270D - Determination of Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Rev. 4, Feb. 2007.

U.S. EPA Method 8000C - Determinative Chromatographic Separations, Rev. 3, Mar. 2003.

U.S. EPA Method 8260C - Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Rev. 3, Aug. 2006.

U.S. EPA Method 8270D - Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Rev. 4, Feb. 2007.

U.S. EPA Method 9060A - Total Organic Carbon, Rev. 1, Nov. 2004.

Table A2a. Geochemical results for Pavillion ground water

Sample ID	T (°C)	pH	SC (µS/cm)	Alkalinity (mg/kg)	Na (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	Cl (ppm)	SO_4 (ppm)	F (ppm)	NO_3 (N) (ppm)
PGDW01	------	------	------	234	808	6.2	398	93.6	34.3	1860	0.4	6.2
PGDW02	13.4	8.11	551	108	86	1.8	34.8	5.3	2.6	175	0.7	<0.5
PGDW03	11.1	9.37	1333	40	272	0.4	16.3	0.3	25.1	549	0.9	<0.5
PGDW04	11.8	9.17	1370	29	270	0.4	18.0	0.1	21.6	551	0.9	<0.5
PGDW05	12.0	9.02	956	93	192	0.3	3.6	0.1	17	295	0.9	<0.5
PGDW06	13.8	10.20	1262	35	249	0.3	7.1	<0.1	31	485	1.3	<0.5
PGDW07	12.4	8.85	1016	61	213	0.3	8.9	0.1	15.7	390	1.2	<0.5
PGDW08	12.4	8.57	1883	83	390	0.6	36.7	0.2	18.9	857	0.5	<0.5
PGDW09	12.4	8.35	1128	254	233	2.1	16.6	4.1	10.5	279	2.4	3.2
PGDW10	12.2	8.95	948	147	204	0.4	6.1	0.1	8.0	293	0.9	<0.5
PGDW11	13.1	7.17	3400	312	423	5.5	363	80.9	15.3	1780	0.2	1.3
PGDW12	12.4	10.04	1344	37	256	0.6	7.8	0.4	30.8	497	1.5	<0.5
PGDW13	10.9	6.89	1155	303	196	1.9	61.0	19.9	6.2	343	0.7	1.0
PGDW14	10.8	7.85	2990	159	690	4.5	154	18.1	26.1	1820	0.4	0.7
PGDW15	11.4	7.48	1728	277	269	1.2	72.2	10.2	9.9	520	0.6	1.8
PGDW16	13.2	9.30	1011	145	188	0.3	6.4	0.1	13.4	258	0.8	<0.5
PGDW17	12.7	9.61	1490	21	278	0.4	21.2	0.5	49.5	583	2.0	<0.5
PGDW18	10.3	8.87	2002	21	509	0.8	84.5	0.3	27	1380	1.8	0.5
PGDW19	11.8	7.75	707	291	194	1.4	29.0	3.2	6.9	196	0.9	2.6
PGDW20	9.3	8.76	2005	70	520	1.0	79.3	9.3	34.5	1370	0.8	<0.5
PGDW22	8.3	6.93	6180	332	837	9.0	416	126	79.9	2720	<0.2	43.6
PGDW23	11.5	9.43	816	61	208	0.3	6.5	0.1	19.8	365	1.2	<0.5
PGDW24	9.7	7.65	4700	165	938	7.0	327	131	55.7	3200	0.6	<0.5
PGDW25	13.3	8.68	972	205	249	1.1	1.1	1.1	8.4	355	4.1	<0.5
PGDW26	9.2	7.13	2390	337	220	6.8	364	57.7	14.6	1240	0.7	1.5
PGDW28	10.7	8.30	1170	258	239	2.2	40.6	12.9	16.7	298	0.5	3.7
PGDW29	11.5	9.72	1442	52	298	0.4	19.7	0.5	52.3	596	0.9	<0.5
PGDW30	10.4	9.60	902	96	210	0.3	0.9	0.1	16.3	331	0.9	<0.5
PGDW31	9.0	8.60	2006	83	435	0.9	31.2	0.8	13.3	1030	0.4	0.5
PGDW32	9.5	10.47	908	34	199	0.3	7.2	<0.1	34.1	373	2.3	<0.5
PGDW33	3.7	7.77	1662	276	178	5.0	228	40.9	28	670	0.2	2.1
PGDW34	8.3	7.87	4480	373	786	7.4	325	113	23	2690	0.5	3.5
PGDW35	10.6	8.63	2810	84	587	1.1	118	1.1	24.1	1610	0.3	0.5
PGDW36	9.8	7.62	649	232	42	2.6	89.5	28.9	3.2	195	1.0	1.2
PGDW37	10.5	8.14	819	342	187	0.9	12.1	1.3	8.7	89.9	0.9	1.2
PGDW38	9.5	8.68	2030	47	373	2.3	70.0	2.3	46.9	908	1.3	5.9
PGDW39	6.7	7.79	6410	127	1110	5.3	389	147	52.9	3640	0.4	0.6
PGDW40	11.5	9.06	1229	86	244	5.0	6.6	5.0	13.1	426	-----	<0.3
PGDW41	7.2	7.63	4470	108	1030	2.7	270	57.5	31.4	2670	0.5	<0.3
PGDW42	12.1	9.18	888	89	181	5.0	5.1	5.0	13.2	311	1.0	<0.3
PGDW43	0.2	8.19	4410	113	911	5.0	208	13.7	38.4	2470	0.4	<0.3
PGDW44	9.4	8.13	4080	100	994	5.0	259	28.3	39.5	2880	0.3	<0.3
PGDW45	9.3	7.63	1103	379	59	2.6	138	31.2	14.5	213	1.9	0.3
PGDW46	7.9	7.79	855	329	91	1.8	90.3	9.9	8.4	126	0.5	2.3
PGDW47	8.2	9.52	970	44	183	5.0	6.9	5.0	21.6	330	1.5	<0.3
PGDW48	8.7	8.21	3550	90	725	5.0	147	4.4	24.1	1840	0.3	<0.3
PGDW49	7.8	7.66	5470	243	1210	11.4	486	153	64.3	3160	0.4	7.7
PGDW03-0110	8.3	8.71	1390	28	251	5.0	16.3	5.0	20.7	570	0.8	<0.3
PGDW04-0110	8.3	9.07	1388	38	265	5.0	15.5	5.0	23.3	532	0.9	-----
PGDW05-0110	9.4	8.22	900	88	188	5.0	3.3	5.0	16.5	287	0.9	<0.3
PGDW10-0110	10.4	8.62	985	147	195	5.0	5.8	5.0	7.5	293	0.9	<0.3
PGDW20-0110	9.3	8.89	2690	68	550	5.0	71.7	8.1	32.6	1270	0.8	<0.3
PGDW22-0110	8.2	7.06	4230	337	908	5.8	397	130	74.6	2780	-----	40.7
PGDW23-0110	8.2	9.72	780	54	194	5.0	5.8	5.0	19.7	368	1.5	<0.3
PGDW25-0110	7.2	7.94	1511	295	269	5.0	70.1	9.6	9.5	441	-----	1.7
PGDW30-0110	9.2	9.39	967	94	195	5.0	4.1	5.0	15.5	333	0.9	<0.3
PGDW32-0110	8.3	9.87	1018	32	193	5.0	6.9	5.0	21.4	368	2.4	<0.3

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Sample ID	T (°C)	pH	SC (µS/cm)	Alkalinity mg/kg	Na (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	Cl (ppm)	SO_4 (ppm)	F (ppm)	NO_3 (N) (ppm)
MW01	11.8	11.91	3265	430	334	54.9	15.6	0.05	23.3	398	1.6	0.15
MW02	12.3	12.01	3812	456	420	39.5	73.3	0.03	466	12.1	1.0	0.38
RD01	11.5	9.24	1068	78	208	0.2	4.3	0.10	15.2	357	1.0	0.23
LD01	10.9	8.85	2940	54	562	1.1	71.9	8.1	33.0	1320	0.9	0.35
PGDW05-0411	10.5	9.06	820	80	190	0.24	3.35	0.08	16.8	276	1.2	ND
PGDW14-0411	8.5	7.73	3473	156	753	3.52	154	18.6	23.7	1760	<0.05	0.36
PGDW20-0411	8.3	8.59	2430	102	520	0.78	63	6.86	22.9	1150	1.3	<0.03
PGDW23-0411	11.0	9.07	959	72	208	0.31	6.7	0.17	19.9	365	1.6	<0.03
PGDW26-0411	8.3	6.95	2390	196	232	5.15	334	56	13.2	1180	1.0	1.37
PGDW30-0411	10.4	8.92	938	82	210	0.29	4.5	0.09	16.1	327	1.1	<0.03
PGDW32-0411	11.1	9.30	885	46	198	0.09	7.2	0.03	18.8	361	2.0	<0.03
PGDW41-0411	8.2	7.05	4866	112	896	3.18	452	46.9	97.6	2640	<0.05	17.5
PGDW44-0411	10.0	8.17	4730	94	1060	2.09	259	19.2	32.1	2900	<0.05	<0.03
PGDW45-0411	9.1	6.85	1085	364	61.6	2.81	159	34.5	18.4	251	1.7	0.64
PGDW49-0411	10.4	7.34	5333	296	982	9.66	417	127	54.3	3200	<0.05	8.75
MW01-0411	11.2	11.24	2352	388	304	24.7	13.6	0.12	23.1	339	1.9	<0.03
MW02-0411	12.0	11.78	3099	482	448	43.6	60.5	0.03	457	63	1.5	<0.03

------ not measured. SC – specific conductance. Alkalinity – mg/kg $CaCO_3$. Other cations detected include Al (0.05 to 0.74 ppm), Ba (0.01 to 0.21 ppm), Fe (<0.02 to 2.4 ppm), Mn (<0.01 to 0.23 ppm), NH_4^+ (0.4 to 4.6 ppm), and Sr (0.06 to 8.4 ppm). Sulfide was detected in LD01 (0.16 ppm, Phase III, same location as PGDW20), PGDW20 (0.12 ppm, Phase IV), and MW01 (1.1 ppm Phase III, 1.8 ppm Phase IV). Turbidity ranged from 1.7 to 29.7 in domestic wells (Phase III and IV). Turbidity in MW01 was 7.5 (Phase III) and 7.9 (Phase IV). Turbidity in MW02 was 28.8 (Phase III) and 24.0 (Phase IV). All turbidity values are in Nephelometric Turbidity Units (NTUs). Turbidity measurements in MW01 and MW02 could be impacted by gas exsolution.

Table A2b. Charge balance calculations for deep monitoring wells

Well	Phase	Ca, meq	Mg, meq	Na, meq	K, meq	SO_4, meq	CO_3, meq	Cl, meq	F, meq	OH, meq	Σcat, meq	Σan, meq	Balance, %
		cations				*anions*							
MW01	III	0.78	0.00	14.53	1.40	8.29	4.48	0.66	0.08	9.56	16.71	23.08	16.0
MW02	III	3.66	0.00	18.27	1.01	0.25	3.40	13.14	0.05	12.04	22.94	28.89	11.5
MW01	IV	0.68	0.01	13.22	0.63	7.06	2.12	0.65	0.10	1.97	14.54	11.90	10.0
MW02	IV	3.02	0.00	19.49	1.12	1.30	0.23	12.89	0.08	7.01	23.62	21.52	4.7

Balance (%) = |(Σcat-Σan)/(Σcat+Σan)*100|. meq OH is calculated as $1000*[a_{OH^-}/\gamma_{OH^-}]$, where $a_{OH^-} = 10^{-(14-pH)}$ and γ_{OH^-} = 0.85 to 0.88. meq CO_3 is estimated from measurements of Dissolved Inorganic Carbon (DIC) as 2*[DIC/12], where DIC is in mg/L.

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Table A3a. Summary of aqueous analysis of light hydrocarbons

Sample (matrix)	Phase	Date	C_1 (ug/l)	C_2 (ug/l)	C_3 (ug/l)	C_4 (ug/l)
MW01(w)	III	10/6/2010	15950	2230	790	158
MW01(w)	IV	4/20/2011	17930	2950	1250	172
MW02(w)	III	10/6/2010	18990	3290	1820	355
MW02(w)	IV	4/19/2011	18820	2550	2260	276
MW02(w)-dup	IV	4/19/2011	22620	3120	2770	356
PGMW01(w)	II	01/21/10	474	nd(10)	nd(15)	------
PGMW02(w)	II	01/21/10	361	299	43.8	------
PGMW03(w)	II	01/21/10	528	nd(10)	nd(15)	------
PGDW03(w)	II	01/20/10	nd(5.0)	nd(10)	nd(15)	------
PGDW04(w)	I	03/03/09	nd(5.0)	------	------	------
PGDW04(w)	II	01/21/10	nd(5.0)	nd(10)	nd(15)	------
PGDW05(w)	I	03/03/09	16.6	------	------	------
PGDW05(w)	II	01/18/10	5.44	nd(10)	nd(15)	------
PGDW05(w)	IV	04/19/11	65*	discarded	nd(1.3)	nd(1.6)
PGDW07(w)	I	03/03/09	nd(5.0)	------	-----	------
PGDW10(w)	I	03/03/09	nd(5.0)	------	-----	------
PGDW10(w)	II	01/18/10	nd(5.0)	nd(10)	nd(15)	------
PGDW14(w)	IV	04/20/11	discarded	nd(1.3)	nd(1.4)	nd(1.7)
PGDW17(w)	I	03/04/09	10.6	------	-----	------
PGDW20(w)	I	03/04/09	137	------	-----	------
PGDW20 (w)	III	10/06/10	189	24.3	nd(0.22)	nd(0.21)
PGDW20(w)-dup	III	10/06/10	168	17.4	nd(0.22)	nd(0.21)
PGDW20(w)	IV	04/18/11	137	discarded	nd(1.43)	2.93
PGDW21(w)	I	03/04/09	54.3	------	-----	------
PGDW22(w)	I	03/04/09	nd(5.0)	------	-----	------
PGDW22(w)	II	01/18/10	nd(5.0)	nd(10)	nd(15)	------
PGDW23(w)	I	03/04/09	146	------	-----	------
PGDW23(w)	II	01/18/10	149	nd(10)	nd(15)	------
PGDW23(w)	IV	04/21/11	176	nd(5.7)	nd(6.6)	nd(6.9)
PGDW25(w)	II	01/19/10	nd(5.0)	nd(10)	nd(15)	------
PGDW26(w)	I	03/05/09	nd(5.0)	------	-----	------
PGDW26(w)	IV	04/18/11	nd(2.2)*	nd(1.4)	nd(1.5)	nd(1.8)
PGDW29(w)	I	03/05/09	nd(5.0)	------	-----	------
PGDW30(w)	I	03/05/09	558	------	-----	------
PGDW30(w)	II	01/19/10	808	nd(10)	nd(15)	-----
PGDW30(w)	III	10/05/10	762	nd(0.19)	nd(0.23)	nd(0.21)
PGDW30(w)	IV	04/18/11	644	discarded	nd(1.5)	4.6
PGDW32(w)	I	03/05/09	21.4	------	-----	------

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Sample (matrix)	Phase	Date	C_1 (ug/l)	C_2 (ug/l)	C_3 (ug/l)	C_4 (ug/l)
PGDW32(w)	II	01/20/10	36.3	nd(10.0)	nd(15.0)	-----
PGDW32(w)	IV	04/18/11	nd(2.2)*	nd(1.2)	nd(1.3)	nd(1.5)
PGDW32(w)-dup	IV	04/18/11	discarded	discarded	nd(1.4)	discarded
PGDW35(w)	I	03/05/09	21.6	------	-----	------
PGDW38(w)	I	03/05/09	nd(5.0)	------	-----	------
PGDW39(w)	II	01/19/10	nd(5.0)	nd(10.0)	nd(15.0)	------
PGDW40(w)	II	01/22/10	98.9	nd(10.0)	nd(15.0)	------
PGDW41(w)	II	01/21/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGDW41(w)	IV	04/20/11	385	142	nd(1.35)	discarded
PGDW42(w)	II	01/19/10	60	nd(10.0)	nd(15.0)	------
PGDW43(w)	II	01/21/10	nd(5.0)	nd(10.0)	nd(15.0)	------
PGDW44(w)	II	01/18/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGDW44(w)	IV	4/21/2011	nd(2.2)*	nd(1.3)	nd(1.4)	nd(1.7)
PGDW45(w)	II	01/18/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGDW45(w)	IV	04/19/11	nd(2.2)*	discarded	nd(1.3)	nd(1.6)
PGDW46(w)	II	01/20/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGDW47(w)	II	01/19/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGDW48(w)	II	01/20/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGDW49(w)	II	01/20/10	nd(5.0)	nd(10.0)	nd(15.0)	------
PGDW49(w)	IV	4/20/2011	nd(2.2)*	discarded	nd(1.3)	nd(1.6)
LD02(w)	III	10/20/2010	229	21	nd(0.24)	nd(0.23)
PGPW01(w)	II	01/20/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
PGPW02(w)	II	01/20/10	nd(5.0)	nd(10.0)	nd(15.0)	-----
Travel Blank(w)	III	10/6/2010	23.3	nd(2.0)	nd(0.24)	nd(0.23)
Equipment Blank(w)	III	10/6/2010	23.0	nd(2.0)	nd(0.29)	nd(0.27)
Field Blank(w)	III	10/6/2010	76.4	nd(2.0)	nd(0.28)	nd(0.26)
Travel Blank(w)	IV	4/14/2011	18.5	56.4	nd(1.63)	nd(1.6)
Field Blank(w)	IV	4/18/2011	45.0	67.9	nd(1.36)	nd(1.66)
equipment blank(w) (on-site GC analysis)	IV	4/18/2011	nd(2.2)	-----	-----	-----
equipment blank(w) (on-site GC analysis)	IV	4/19/2011	nd(2.2)	-----	-----	-----
equipment blank(w) (on-site GC analysis)	IV	4/20/2011	nd(2.2)	-----	-----	-----
equipment blank(w) (on-site GC analysis)	IV	4/20/2011	nd(2.2)	-----	------	------
field blank(w)	IV	4/21/2011	nd(0.32)	nd(1.18)	nd(1.27)	nd(1.54)

* Determined by on-site GC analysis in Phase IV. Fixed laboratory analysis rejected in Phase IV if detection of methane and ethane less than 100 µg/L.
All values of methane in Phase III greater than 100 µg/L accepted.
Ultrapure nitrogen was used for equipment and travel blanks for on-site GC analysis.
nd() - not detected(detection limit) ------ not analyzed

Table A3b. Summary of gas and headspace analysis of light hydrocarbons

Sample (matrix)	Phase	Date	C_1 (%)	C_2 (%)	C_2H_4 (%)	C_3 (%)	iC_4 (%)	nC_4 (%)	iC_5 (%)	nC_5 (%)	C_6+ (%)
Tribal Pavillion 14-6(g) (WR)	----	Johnson and Rice (1993)	95.28	2.83	-----	0.3	0.11	0.18	0.05	0.02	-----
Govt 21-5(g) (WR)	----	Johnson and Rice (1993)	93.24	3.75	-----	0.73	0.33	0.22	0.16	0.09	-----
Tribal Pavillion 41-09(g) (FU)	----	Johnson and Rice (1993)	88.17	3.35	-----	0.36	0.14	0.09	nd	nd	-----
Tribal Pavillion 14-11(g) (FU)	----	Johnson and Rice (1993)	66.00	1.96	-----	0.06	0.054	0.006	0.006	0.002	-----
Blankenship 4-8(g) (FU)	----	Johnson and Rice (1993)	93.38	4.00	-----	0.41	0.05	0.06	0.07	0.01	-----
Tribal Pavillion 14-10(g) (WR)(PGPP01)	II	01/21/10	92.47	4.04	0.001	1.21	0.415	0.372	0.183	0.114	0.486
Tribal Pavillion 43-10(g) (FU)(PGPP02)	II	01/21/10	94.86	3.48	0.0001	0.356	0.143	0.0618	0.0501	0.0194	0.18
Tribal Pavillion 24-2(g) (WR)(PGPP04)	II	01/21/10	90.16	4.64	0.0017	1.46	0.581	0.512	0.335	0.211	1.39
Tribal Pavillion 33-10(g) (FU)(PGPP05)	II	01/21/10	94.68	3.64	nd	0.373	0.131	0.055	0.0427	0.014	0.107
Tribal Pavillion 14-2(g) (FU)(PGPP06)	II	01/21/10	93.23	3.93	0.0012	0.903	0.321	0.25	0.151	0.0905	0.506
MW01(g)	III	9/23/2010	84.22	3.43	0.0007	0.791	0.327	0.191	0.143	0.0632	0.111
MW01(w)	III	10/6/2010	35.11	2.02	0.0008	0.414	0.114	0.0871	0.0499	0.0241	0.0539
MW01(g)	IV	4/18/2011	89.43	3.92	0.0013	0.907	0.298	0.211	0.109	0.0574	0.0972
MW01(g)-dup	IV	4/18/2011	89.49	3.91	0.0013	0.902	0.295	0.206	0.103	0.0533	0.0804
MW01(w)	IV	4/20/2011	38.33	2.46	0.0016	0.504	0.113	0.101	0.0422	0.0229	0.0566
MW02(g)	III	9/24/2010	1.05	0.048	nd	0.022	0.0089	0.0053	0.0020	0.0008	0.0012
MW02(g)-dup	III	9/24/2010	1.04	0.048	nd	0.022	0.0089	0.0053	0.0020	0.0008	0.0009
MW02(w)	III	10/6/2010	28.03	2.16	nd	0.693	0.128	0.101	0.0185	0.0067	0.0174
MW02(g)	IV	4/18/2011	6.74	0.383	nd	0.142	0.0401	0.026	0.0070	0.0025	0.0034
MW02(g)-dup	IV	4/18/2011	7.41	0.422	nd	0.156	0.0439	0.0284	0.0077	0.0027	0.0035
MW02(w)	IV	4/19/2011	26.17	1.80	nd	0.765	0.259	0.147	0.0416	0.0141	0.0237
MW02(w)-dup	IV	4/19/2011	21.32	1.49	nd	0.623	0.204	0.118	0.0324	0.011	0.018
PGMW01(w)	II	01/21/10	2.47	nd	nd	nd	0.0054	0.005	0.0287	0.0092	0.537
PGMW02(w)	II	01/21/10	3.57	1.13	nd	0.103	0.402	0.0134	0.13	0.0003	0.398
PGDW03(w)	II	01/20/10	0.0122	nd	nd	nd	nd	nd	nd	nd	nd
PGDW04(w)	II	01/21/10	0.0036	nd	nd	nd	nd	nd	nd	nd	nd
PGDW05(w)	IV	04/19/11	0.0966	nd	nd	nd	nd	nd	nd	nd	nd
PGDW10(w)	II	01/18/10	0.0266	nd	nd	nd	nd	nd	nd	nd	nd
PGDW14(w)	IV	04/20/11	0.0005	nd	nd	nd	nd	nd	nd	nd	nd

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Sample (matrix)	Phase	Date	C_1 (%)	C_2 (%)	C_2H_4 (%)	C_3 (%)	iC_4 (%)	nC_4 (%)	iC_5 (%)	nC_5 (%)	C_6+ (%)
PGDW20 (w)	III	10/06/10	0.191	0.007	nd	0.0006	nd	nd	nd	nd	nd
PGDW20(w)-dup	III	10/06/10	0.134	0.005	nd	nd	nd	nd	nd	nd	nd
PGDW20(w)	IV	04/18/11	0.221	0.007	nd	0.0007	nd	nd	nd	nd	nd
PGDW22(w)	II	01/18/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
PGDW23(w)	IV	04/21/11	0.248	nd	nd	nd	nd	0.0015	nd	nd	0.0008
PGDW25(w)	II	01/19/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
PGDW26(w)	IV	04/18/11	nd	nd	nd	nd	nd	nd	nd	nd	nd
PGDW30(w)	II	01/19/10	5.99	nd	nd	nd	nd	nd	nd	nd	nd
PGDW30(g)	III	09/23/10	0.0123	nd	nd	nd	nd	nd	nd	nd	nd
PGDW30(w)	III	10/05/10	1.19	nd	nd	nd	nd	nd	nd	nd	nd
PGDW30(w)	IV	04/18/11	1.46	nd	nd	nd	nd	nd	nd	nd	nd
PGDW32(w)	II	01/20/10	0.197	nd	nd	nd	nd	nd	nd	nd	0.0085
PGDW32(w)	IV	04/18/11	0.0752	nd	nd	nd	nd	nd	nd	nd	0.0019
PGDW32(w)-dup	IV	04/18/11	0.0522	nd	nd	nd	nd	nd	nd	nd	0.0013
PGDW39(w)	II	01/19/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
PGDW40(w)	II	01/22/10	0.418	nd	nd	nd	nd	nd	nd	nd	nd
PGDW41(w)	II	01/21/10	0.0091	nd	nd	nd	nd	nd	nd	nd	nd
PGDW41(w)	IV	04/20/11	0.0005	nd	nd	nd	nd	nd	nd	nd	nd
PGDW42(w)	II	01/19/10	0.291	nd	nd	nd	nd	nd	nd	nd	nd
PGDW43(w)	II	01/21/10	0.0016	nd	nd	nd	nd	nd	nd	nd	nd
PGDW44(w)	IV	4/21/11	0.0022	nd	nd	nd	nd	nd	nd	nd	nd
PGDW45(w)	II	01/18/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
PGDW45(w)	IV	04/19/11	nd	nd	nd	nd	nd	nd	nd	nd	nd
PGDW46(w)	II	01/20/10	0.0016	nd	nd	nd	nd	nd	nd	nd	nd
PGDW47(w)	II	01/19/10	0.0428	nd	nd	nd	nd	nd	nd	nd	nd
PGDW47(w)-dup	II	01/19/10	0.0365	nd	nd	nd	nd	nd	nd	nd	nd
PGDW49(w)	IV	4/20/11	nd	nd	nd	nd	nd	nd	nd	nd	nd
LD02(w)	III	10/20/10	0.12	0.007	nd	0.001	0.0008	0.0007	nd	0.0005	nd
PGPW01(w)	II	01/20/10	0.0253	nd	nd	nd	nd	nd	nd	nd	nd
PGPW02(w)	II	01/20/10	0.0389	nd	nd	nd	nd	nd	nd	nd	nd
field blank(w)	II	01/21/10	0.0068	nd	nd	nd	nd	nd	nd	nd	0.0021
field blank(w)	II	01/22/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
travel blank(g)	III	9/23/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
equipment blank(g)	III	9/23/10	0.0029	nd	nd	nd	nd	nd	nd	nd	nd
travel blank(g)	III	9/24/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
equipment blank(g)	III	9/24/10	nd	nd	nd	nd	nd	nd	nd	nd	nd
travel blank(g)	IV	4/18/11	nd	nd	nd	nd	nd	nd	nd	nd	nd
equipment blank(g)	IV	4/18/11	nd	nd	nd	nd	nd	nd	nd	nd	nd
equipment blank(g)	IV	4/18/11	nd	nd	nd	nd	nd	nd	nd	nd	nd

WR - Wind River Formation FU - Fort Union Formation ----- not analyzed nd () not detected

Table A3c. Summary of isotopic data for dissolved, gas phase, and headspace analysis

Sample (matrix)	Phase	Date	$\delta^{13}C$-C_1 (‰)	δD-C_1 (‰)	$\delta^{13}C$-C_2 (‰)	δD-C_2 (‰)	$\delta^{13}C$-C_3 (‰)	δD-C_3 (‰)	$\delta^{13}C$-iC_4 (‰)	δD-iC_4 (‰)	$\delta^{13}C$-nC_4 (‰)	δD-nC_4 (‰)	$\delta^{13}C$-iC_5 (‰)	$\delta^{13}C$-nC_5 (‰)	$^{14}C_1$ (pMC)	$\delta^{13}C$ DIC (‰)	$\delta^{18}O$ H_2O (‰)	δD H_2O (‰)
Tribal Pavillion 14-6(g) (WR)	----	Johnson and Rice (1993)	-39.24	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Govt 21-5(g) (WR)	----	Johnson and Rice (1993)	-40.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Tribal Pavillion 41-09(g) (FU)	----	Johnson and Rice (1993)	-38.04	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Tribal Pavillion 14-11(g) (FU)	----	Johnson and Rice (1993)	-38.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Blankenship 4-8(g) (FU)	----	Johnson and Rice (1993)	-38.08	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Tribal Pavillion 14-10(g) (WR)(PGPP01)	II	01/21/10	-38.75	-203.4	-26.93	-162.5	-24.93	-147.2	-25.83	-152.4	-25.26	-151.3	-----	-----	-----	-----	-----	-----
Tribal Pavillion 43-10(g) (FU)(PGPP02)	II	01/21/10	-39.07	-212.9	-25.99	-157.5	-19.4	-----	-----	-----	-23.87	-----	-----	-----	-----	-----	-----	-----
Tribal Pavillion 24-2(g) (WR)(PGPP04)	II	01/21/10	-39.26	-204.9	-26.79	-166.2	-25.33	-148.0	-25.66	-155.5	-25.05	-154	-----	-----	-----	-----	-----	-----
Tribal Pavillion 33-10(g) (FU)(PGPP05)	II	01/21/10	-39.05	-207.3	-26.21	-161.1	-18.46	-101.7	-23.96	-----	-23.64	-----	-----	-----	-----	-----	-----	-----
Tribal Pavillion 14-2(g) (FU)(PGPP06)	II	01/21/10	-39.28	-215.3	-26.42	-162.3	-24.01	-145.2	-25.33	-150.1	-24.87	-152	-----	-----	-----	-----	-----	-----
MW01(g)	III	9/23/2010	-39.44	-209.1	-26.63	-165.0	-23.76	-143.7	-----	-----	-----	-----	-----	-----	<0.2	-----	-----	-----
MW01(w)	III	10/6/2010	-38.89	-191.3	-26.55	-----	-23.85	-----	-----	-----	-----	-----	-----	-----	-----	-12.18	-13.77	-113.77
MW01(g)	IV	4/18/2011	-39.25	-211.2	-26.67	-166.8	-23.74	-146.1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MW01(g)-dup	IV	4/18/2011	-39.28	-210.1	-26.67	-167.4	-23.91	-146.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MW01(w)	IV	4/20/2011	-38.88	-211.6	-26.70	-----	-24.40	-----	-25.3	-----	-24.4	-----	-25.0	-24.7	-----	-12.01	-13.26	-109.53
MW02(g)	III	9/24/2010	-41.85	-209.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	< 0.2	-----	-----	-----
MW02(g)-dup	III	9/24/2010	-41.72	-209.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	< 0.2	-----	-----	-----

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Sample (matrix)	Phase	Date	$\delta^{13}C$-C_1 (‰)	δD-C_1 (‰)	$\delta^{13}C$-C_2 (‰)	δD-C_2 (‰)	$\delta^{13}C$-C_3 (‰)	δD-C_3 (‰)	$\delta^{13}C$-iC_4 (‰)	δD-iC_4 (‰)	$\delta^{13}C$-nC_4 (‰)	δD-nC_4 (‰)	$\delta^{13}C$-iC_5 (‰)	$\delta^{13}C$-nC_5 (‰)	$^{14}C_1$ (pMC)	$\delta^{13}C$ DIC (‰)	$\delta^{18}O$ H_2O (‰)	δD H_2O (‰)
MW02(w)	III	10/6/2010	-41.83	-203.8	-26.4	-----	-24.28	-----	-----	-----	-----	-----	-----	-----	-----	Low DIC	-15.55	-117.41
MW02(g)	IV	4/18/2011	-41.05	-208.9	-26.10	-170.5	-24.05	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MW02(g)-dup	IV	4/18/2011	-41.01	-210.8	-26.09	-171.4	-24.06	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
MW02(w)	IV	4/19/2011	-41.30	-210.7	-26.25	-----	-24.29	-----	-25.3	-----	-24.3	-----	-----	-----	-----	Low DIC	-14.24	-113.42
MW02(w)-dup	IV	4/19/2011	-41.37	-208.2	-26.28	-----	-24.28	-----	-25.3	-----	-24.5	-----	-----	-----	-----	Low DIC	-14.27	-113.46
PGDW05(w)	IV	04/19/11	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-15.12	-13.11	-109.64
PGDW14(w)	IV	04/20/11	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-11.94	-15.79	-126.04
PGDW20 (w)	III	10/06/10	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-16.04	-13.22	-107.70
PGDW20(w)-dup	III	10/06/10	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-15.91	-13.18	-107.38
PGDW20(w)	IV	04/18/11	-33.1	-175	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-16.24	-13.31	-108.35
PGDW23(w)	IV	04/21/11			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-13.29	-12.40	-97.35
PGDW30(w)	II	01/19/10	-28.77	-143.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
PGDW30(w)	III	10/05/10	-28.76	-145.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-12.18	-13.02	-109.78
PGDW30(w)	IV	04/18/11	-27.8	-133	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-11.66	-13.23	-108.11
PGDW32(w)	IV	04/18/11	-34.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-11.32	-13.33	-108.10
PGDW32(w)-dup	IV	04/18/11	-34.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-10.84	-13.28	-108.24
PGDW41(w)	IV	04/20/11	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-12.31	-15.91	-121.93
PGDW44(w)	IV	4/21/2011	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-10.35	-13.29	-100.29
PGDW45(w)	IV	04/19/11	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-14.18	-16.59	-128.18
PGDW49(w)	IV	4/20/2011	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-11.05	-15.57	-122.19
LD02(w)	III	10/20/2010	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-18.58	-13.22	-109.20

WR - Wind River Formation   FU - Fort Union Formation   ----- not analyzed   nd () - not detected

Appendix B

Quality Assurance and Quality Control (QA/QC) for Analysis

Table B1. Sample collection containers, preservation, and holding times for ground-water samples for Phase III and IV

Sample Type	Analysis Method (EPA Method)	Sample Bottles/# of bottles*	Preservation/ Storage	Holding Time(s)
Dissolved gases	RSKSOP-194v4 &-175v5 (No EPA Method)	60 mL serum bottles/2	No Headspace TSP†, pH>10; refrigerate 4°C††	14 days
Metals (filtered)	RSKSOP-213v4 &-257v3 (EPA Methods 200.7 and 6020)	125 mL plastic bottle/1	HNO_3, pH<2; room temperature	6 months (Hg 28 days)
SO_4, Cl, F, Br	RSKSOP-276v3 (EPA Method 6500)	30 mL plastic/1	Refrigerate ≤4°C	28 days
$NO_3 + NO_2$, NH_4	RSKSOP-214v5 (EPA Method 350.1 and 353.2)	30 mL plastic/1	H_2SO_4, pH<2; refrigerate ≤4°C	28 days
DIC	RSKSOP-102v5 or 330v0 (EPA Method 9060A)	40 mL clear glass VOA vial/2	refrigerate ≤4°C	14 days
DOC	RSKSOP-102v5 or 330v0 (EPA Method 9060A)	40 mL clear glass VOA vial/2	H_3PO_4, pH<2; refrigerate ≤4°C	28 days
VOCs	RSKSOP-299v1 or 259v1 (EPA Method 5021A plus 8260C)	40 mL amber glass VOA vial/2	No Headspace TSP†, pH>10; refrigerate ≤4°C	14 days
Low Molecular Weight Acids	RSKSOP-112V6 (No EPA Method)	40 mL glass VOA vial/2	TSP†, pH>10; refrigerate ≤ 4°C	30 days
O, H stable isotopes of water	RSKSOP-296v0 (No EPA Method)	20 mL glass VOA vial/1	Refrigerate at ≤ 4°C	Stable
$\delta^{13}C$ DIC	Isotech: gas stripping and IRMS (No EPA Method)	60 mL plastic bottle/1	Refrigerate ≤4°C	No information
$\delta^{13}C$ and δD of methane	Isotech: gas stripping and IRMS (No EPA Method)	1 L plastic bottle/1	Caplet of benzalkonium chloride; refrigerate ≤4°C	No information
SVOCs	ORGM-515 r1.1, EPA Method 8270D	1L amber glass bottle/2 and for every 10 samples of ground water need 2 more bottles for one selected sample, or if <10 samples collected, collect 2 more bottles for one select sample	Refrigerate ≤4°C	7 days until extraction, 30 days after extraction
DRO	ORGM-508 r1.0, EPA Method 8015D	1L amber glass bottle/2 and for every 10 samples of ground water need 2 more bottles for one selected sample, or if <10 samples collected, collect 2 more bottles for one select sample	HCl, pH<2; refrigerate ≤4°C	7 days until extraction, 40 days after extraction
GRO	ORGM-506 r1.0, EPA Method 8015D	40 mL amber glass VOA vial/2 and for every 10 samples of ground water need 2 more bottles for one selected sample, or if <10 samples collected, collect 2 more bottles for one select sample	No headspace; HCl, pH<2; refrigerate ≤4°C	14 days
Glycols	Region III method** (No EPA Method)	40 mL amber glass VOA vial/2	Refrigerate ≤4ºC	14 days

† Trisodium phosphate
†† Above freezing point of water
*Spare bottles made available for laboratory QC samples and for replacement of compromised samples (broken bottle, QC failures, etc.).
**EPA Methods 8000C and 8321 were followed for method development and QA/AC limits were applicable.

Table B2. Field QC samples for ground-water analysis			
QC Sample	**Purpose**	**Method**	**Frequency**
Trip Blanks (VOCs and Dissolved Gases only)	Assess contamination during transportation.	Fill bottles with reagent water and preserve, take to field and returned without opening.	One in an ice chest with VOA and dissolved gas samples.
Equipment Blanks	Assess contamination from field equipment, sampling procedures, decontamination procedures, sample container, preservative, and shipping.	Apply only to samples collected via equipment, such as filtered samples: Reagent water is filtered and collected into bottles and preserved same as filtered samples.	One per day of sampling with submersible pumps
Field Duplicates	Represent precision of field sampling, analysis, and site heterogeneity.	One or more samples collected immediately after original sample.	One in every 10 samples, or if <10 samples collected for a water type (ground or surface), collect a duplicate for one sample.
Temperature Blanks	Measure temperature of samples in the cooler.	Water sample that is transported in cooler to lab.	One per cooler.
Field Blanks**	Assess contamination introduced from sample container with applicable preservative.	In the field, reagent water is collected into sample containers with preservatives.	One per day of sampling.

* Reporting limit or Quantitation Limit

** Blank samples were not collected for isotope measurements, including O, H, C.

Table B3. QA/QC requirements for analysis of metals and major ions						
Measurement	**Analysis Method**	**Blanks (Frequency)**	**Calibration Checks (Frequency)**	**Second Source (Frequency)**	**Duplicates (Frequency)**	**Matrix Spikes (Frequency)**
Metals	RSKSOP-213v4 (EPA Methods 200.7 and 6020)	<QL for 80% of metals; (Beginning and end of each sample queue, 10-15 samples)	90-110% of known value (Beginning and end of each sample queue, 10-15 samples)	PE sample acceptance limits or 90-110% of known value (Immediately after first calibration check)	RPD<10 for 80% of metals; for results <5x QL, difference of $\leq$QL(Every 15 samples)	90-110% Rec. for 80% of metals w/ no individual exceeding 50-150% Rec. (one per sample set, 10-15 samples)
Metals	RSKSOP-257v3 (EPA Methods 200.7 and 6020)	<QL for 80% of metals; none>10xMDL (Beginning and end of each sample queue, 10-15 samples)	90-110% of known value (Beginning and end of each sample queue, 10-15 samples)	PE sample acceptance limits or 90-110% of known value (Immediately after first calibration check)	RPD<10 for 80% of metals; for results <5xQL, difference of <QL (Every 15 samples)	90-110% Rec. for 80% of metals w/ no individual exceeding 70-130% (one per sample set, 10-15 samples)
SO_4, Cl, F, Br	RSKSOP-2 (EPA Method 6500)76v3	<MDL (Beginning and end of each sample queue)	90-110% Rec. (Beginning, end, and every 10 samples)	PE sample acceptance limits (One per sample set)	RPD<10 (every 15 samples)	80-120% Rec. (one per every 20 samples)
$NO_3 + NO_2$, NH_4	RSKSOP-214v5 (EPA Method 350.1 and 353.2)	<½ lowest calib. std. (Beginning and end of each sample queue)	90-110% Rec. (Beginning, end, and every 10 samples)	PE sample acceptance limits (One per sample set)	RPD<10 (every 10 samples)	80-120% Rec. (one per every 20 samples)

Table B4. QA/QC requirements for analysis of dissolved gases, DIC/DOC, VOCs, low molecular weight acids and stable isotopes of water

Measurement	Analysis Method	Blanks (Frequency)	Calibration Checks (Frequency)	Second Source (Frequency)	Duplicates (Frequency)	Matrix Spikes (Frequency)
Dissolved gases	RSKSOP-194v4 &-175v5* (No EPA Method)	≤MDL (He/Ar blank, first and last in sample queue; water blank before samples)	85-115% of known value (After helium/Ar blank at first of analysis queue, before helium/Ar blank at end of sample set, and every 15 samples)	85-115% of known value (After first calibration check)	RPD≤20 (Every 15 samples)	NA
DIC/DOC	RSKSOP-102v5 (Phase III) or 330v0 (Phase IV) (EPA Method 9060A)	- 102v5: <½QL (after initial calib., every 10-15 samples, and at end) -330v0: < MDL (Beginning and end of sample set)	-102v5: 80-120% of known value (after initial calib., every 10-15 samples, and at end-330v0: 90-100% of known value (Beginning and end of sample set and every 10 samples)	-102v5: 80-120% of known value (Immediately after calibration) -330v0: PE sample reported acceptance limits. Others: 90-100% recovery (one per sample set)	-102v5: RPD<10 (every 15 samples) -330v0: RPD<10 (every 10 samples)	-102v5:80-120% Rec. (one per 20 or every set) -330v0:80-120% Rec.
Volatile organic compounds (VOC)**	RSKSOP-299v1 and -259v1 (EPA Method 5021A plus 8260C)	<MDL (Beginning and end of each sample set)	80-120% Rec. (Beginning, end, and every 20 samples)	80-120% of known value Once at beginning (and at end for -259v1)	-299v1 RPD<20 -259v1 RPD<25 (every 20 samples)	70-130% Rec. (every 20 samples)
Low Molecular Weight Acids	RSKSOP-112v6 (No EPA Method)	<MDL (Beginning of a sample queue; every 10 samples; and end of sample queue)	85-115% of the recovery (Prior to sample analysis; every 10 samples; end of sample queue)	85-115% of recovery (Prior to sample analysis)	< 15 RPD (Every 20 samples through a sample queue)	80-120 % recovery (Every 20 samples through a sample queue)
O, H stable isotopes of water***	RSKSOP-296v1 (No EPA Method)	NA	Difference of calibrated/true < 1‰ for δ^2H & < 0.2‰ for δ^{18}O (Beginning, end and every tenth sample)	Working stds calibrated against IAEAstds.† (Beginning, end, and every tenth sample)	Standard deviation ≤ 1‰ for δ^2H and < 0.2‰ for δ^{18}O (every sample)	NA

*This table only provides a summary; SOPs should be consulted for greater detail.
**Surrogate compounds spiked at 100 ug/L: p-bromofluorobenzene and 1,2-dichlorobenzene-d4, 85-115% recovery.
***Additional checks: internal reproducibility prior to each sample set, std dev≤ 1‰ for δ^2H and ≤ 1‰ for δ^{18}O
†International Atomic Energy Agency (VSMOW, GISP, and SLAP)
Corrective actions are outlined in the SOPs.
MDL = Method Detection Limit
QL = Quantitation Limit
PE = Performance Evaluation

Table B5. QA/QC requirements for analysis of semi-volatiles, GRO, and DRO

QC Type	Semivolatiles	DRO	GRO	Frequency
Method Blanks	<RL Preparation or Method Blank, one with each set of extraction groups. Calibration Blanks are also analyzed	<RL Preparation or Method Blank	<RL Preparation or Method Blank and IBL	At least one per sample set
Surrogate Spikes	Limits based upon DoD statistical study (rounded to 0 or 5) for the target compound analyses.	60-140% of expected value	70-130% of expected value	Every field and QC sample
Internal Standards Verification	Every sample, EICP area within -50% to +100% of last ICV or first CCV.	NA	NA	Every field and QC sample
Initial multilevel calibration	ICAL: minimum of 6 levels (0.25 -12.5 ug/L) , one is at the MRL (0.50 ug/L), prior to sample analysis (not daily) RSD≤20%, r^2≥0.990	ICAL: 10-500 ug/L RSD<=20% or r^2>=0.990	ICAL: .25-12.5 ug/L for gasoline (different range for other compounds) RSD<=20% or r2>=0.990	As required (not daily if pass ICV)
Initial and Continuing Calibration Checks	80-120% of expected value	80-120% of expected value	80-120% of expected value	At beginning of sample set, every tenth sample, and end of sample set
Second Source Standards	ICV1 70-130% of expected value	ICV1 80-120% of expected value	ICVs 80-120% of expected value	Each time calibration performed
Laboratory Control Samples (LCS)	Statistical Limits from DoD LCS Study (rounded to 0 or 5) or if SRM is used based on those certified limits	Use an SRM: Values of all analytes in the LCS should be within the limits determined by the supplier. Otherwise 70-130% of expected value	Use and SRM: Values of all analytes in the LCS should be within the limits determined by the supplier. Otherwise 70-130% of expected value	One per analytical batch or every 20 samples, whichever is greater
Laboratory Control Samples (LCS)	Statistical Limits from DoD LCS Study (rounded to 0 or 5) or if SRM is used based on those certified limits	Use an SRM: Values of all analytes in the LCS should be within the limits determined by the supplier. Otherwise 70-130% of expected value	Use and SRM: Values of all analytes in the LCS should be within the limits determined by the supplier. Otherwise 70-130% of expected value	One per analytical batch or every 20 samples, whichever is greater
Matrix Spikes (MS)	Same as LCS	Same as LCS	70-130% of expected value	One per sample set or every 20 samples, whichever is more frequent
MS/MSD	% Recovery same as MS RPD ≤ 30	% Recovery same as MS RPD ≤ 25	% Recovery same as MS RPD ≤ 25	One per sample set or every 20 samples, whichever is more frequent
Reporting Limits*	0.1 µg/L (generally)[1] for target compounds HF special compounds are higher	20 µg/L[1]	20 µg/L[2]	NA

[1] Based on 1000 mL sample to 1 mL extract
[2] Based on a 5 mL purge

Table B6. QA/QC requirements for LC/MS/MS analysis of glycols

QC Type	Performance Criteria	Frequency
Method Blanks	<RL	One per every 20 samples
Solvent Blanks	<RL	One per every 10 samples
Initial and Continuing Calibration Checks	80-120% of expected value	At beginning of sample set, after every tenth sample, and end of sample set
Second Source Standards	80-120% of expected value	Each time calibration performed
Laboratory Control Samples (LCS)	80-120% of expected value	One per analytical batch or every 20 samples, whichever is greater
Matrix Spikes (MS)	70-130% of expected value	One per sample set or every 20 samples, whichever is more frequent
MS/MSD	RPD $\leq$ 25	One per sample set or every 20 samples, whichever is more frequent

RL = Reporting Limit
Corrective Actions: If re-analysis was not possible (such as lack of sample volume), the data was qualified with a determination about the impact on the sample data.

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Table B7a. ICP-OES blank results for Phase III and Phase IV sampling

Label	Date	Al	Ag	B	Ba	Be	Ca	Co	Fe	K	Mg
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Trip Blank	10/6/2010	nd	nd	nd	nd	nd	nd	BQL 0.001	nd	nd	nd
EQ Blank	10/7/2010	nd	nd	nd	nd	nd	BQL 0.009	nd	nd	nd	BQL 0.017
Field Blank	10/5/2010	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trip Blank	4/14/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Field Blank	4/18/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Field Blank	4/21/2011	nd	nd	nd	nd	nd	nd	nd	nd	BQL 0.096	nd
Equip Blank	4/21/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MDL		0.045	0.015	0.006	0.001	0.001	0.007	0.001	0.019	0.038	0.015
QL		0.149	0.051	0.018	0.004	0.004	0.023	0.004	0.063	0.127	0.049
Detections in samples		17/21	0/21	21/21	21/21	7/21	21/21	2/21	12/21	21/21	21/21
Concentration min		0.054	nd	0.103	0.006	0.001	3.35	0.001	0.019	0.089	0.019
Concentration max		0.736	nd	0.378	0.210	0.003	452	0.002	2.41	54.9	56.0

BQL – below quantitation level. Units are mg/L. nd – not detected. MDL – method detection level. QL – quantitation level. Detections in samples: the number of times the analyte was detected in Phase III and Phase IV sampling. Minimum and maximum sample concentration in Phase III /Phase IV sampling activities in mg/L.

Table B7b. ICP-OES blank results for Phase III and Phase IV sampling

Label	Date	Mn	Mo	Na	Sb	Sr	Ti	Zn	Si	S	P
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Trip Blank	10/6/2010	nd	nd	nd	nd	nd	nd	nd	BQL 0.077	nd	nd
EQ Blank	10/7/2010	BQL 0.001	nd	nd	nd	nd	nd	BQL 0.017	nd	2.04	nd
Field Blank	10/5/2010	nd	nd	nd	nd	nd	nd	BQL 0.011	nd	1.2	nd
Trip Blank	4/14/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	BQL 0.007
Field Blank	4/18/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	BQL 0.009
Field Blank	4/21/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Equip Blank	4/21/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	BQL 0.011
MDL		0.001	0.002	0.040	0.006	0.001	0.001	0.007	0.037	0.121	0.004
QL		0.004	0.007	0.134	0.019	0.004	0.004	0.024	0.122	0.403	0.013
Detections in samples		16/21	14/21	21/21	11/21	21/21	4/21	15/21	21/21	21/21	5/21
Concentration min		0.001	0.006	61.6	0.007	0.058	0.001	0.009	2.93	6.76	0.008
Concentration max		0.231	0.019	1060	0.033	8.44	0.004	0.201	10.2	1140	0.024

BQL – below quantitation level. Units are mg/L. nd – not detected. MDL – method detection level. QL – quantitation level. Detections in samples: the number of times the analyte was detected in Phase III and Phase IV sampling. Minimum and maximum sample concentration in Phase III /Phase IV sampling activities in mg/L.

Table B7c. ICP-MS blank results for Phase III and Phase IV sampling

Label	Date	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Tl	U
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Trip Blank	10/6/2010	BQL 0.096	nd	nd	0.96	0.46	nd	0.981	nd	0.014	-----
EQ Blank	10/7/2010	0.258	nd	0.086	BQL 0.65	nd	0.34	nd	nd	BQL 0.004	-----
Field Blank	10/5/2010	0.263	nd	BQL 0.018	nd	nd	nd	nd	nd	0.014	-----
Trip Blank	4/14/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Field Blank	4/18/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Field Blank	4/21/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Equip Blank	4/21/2011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MDL		0.052	0.020	0.008	0.287	0.019	0.048	0.043	0.044	0.004	0.002
QL		0.173	0.067	0.124	0.957	0.064	0.160	0.143	0.147	0.013	0.007
Detections in samples		18/21	3/21	19/21	19/21	5/21	19/21	11/21	21/21	5/21	15/15
Concentration min		0.255	0.028	0.010	0.380	0.117	0.060	0.123	0.337	0.014	0.005
Concentration max		4.96	0.089	0.864	18.9	0.614	9.62	2.37	16.4	0.125	80.1

BQL – below quantitation level. Units are µg/L. ----- not measured. nd – not detected. MDL – method detection level. QL – quantitation level. Detections in samples: the number of times the analyte was detected in Phase III and Phase IV sampling. Minimum and maximum sample concentration in Phase III/Phase IV sampling activities in µg/L.

Table B8. Blank results for Capillary Electrophoresis, Lachat Flow Injection Analysis, Dissolved Inorganic Carbon (DIC) and Dissolved Organic Carbon analyses for Phase III and Phase IV sampling

Label	Date	Cl	SO_4	F	NO_3+NO_2	NH_4	DIC	DOC
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Trip Blank	10/6/2010	nd	nd	nd	nd	nd	BQL 0.51	BQL 0.06
EQ Blank	10/7/2010	nd	nd	nd	nd	nd	BQL 0.17	BQL 0.03
Field Blank	10/5/2010	nd	nd	nd	nd	nd	BQL 0.08	BQL 0.04
Trip Blank	4/14/2011	nd	nd	nd	nd	nd	BQL 0.09	BQL 0.29
Field Blank	4/18/2011	nd	nd	nd	nd	nd	BQL 0.29	BQL 0.24
Field Blank	4/21/2011	nd	nd	nd	nd	nd	BQL 0.20	BQL 0.17
Equip Blank	4/21/2011	nd	nd	nd	nd	nd	BQL 0.18	BQL 0.28
MDL		0.136	0.103	0.056	0.005	0.014	0.103	0.103
QL		1.00	1.00	0.200	0.100	0.100	0.500	0.500
Detections in samples		21/21	21/21	17/21	11/21	16/21	21/21	21/21
Concentration min		13.2	12.1	0.90	0.08	0.04	1.4	0.51
Concentration max		466	3200	2.02	17.5	4.61	89.1	19.7

BQL – below quantitation level. Units are mg/L. nd – not detected. MDL – method detection level. QL – quantitation level. Detections in samples: the number of times the analyte was detected in Phase III and Phase IV sampling. Minimum and maximum sample concentration in Phase III /Phase IV sampling activities in mg/L.

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Table B9. Blank results for Volatile Organic Compounds (µg/L) in Phase III and Phase IV sampling (Region 8 laboratory, Golden, CO)

	Trip Blank	EQ Blank	Field Blank	Trip Blank	Field Blank	Field Blank	RL
	10/6/2010	10/7/2010	10/5/2010	4/14/2011	4/18/2011	4/21/2011	
1,1,1,2-Tetrachloroethane	nd	nd	nd	nd	nd	nd	0.25
1,1,1-Trichloroethane	nd	nd	nd	nd	nd	nd	0.25
1,1,2,2-Tetrachloroethane	nd	nd	nd	nd	nd	nd	0.25
1,1,2-Trichloroethane	nd	nd	nd	nd	nd	nd	0.25
1,1-Dichloroethane	nd	nd	nd	nd	nd	nd	0.25
1,1-Dichloroethene	nd	nd	nd	nd	nd	nd	0.25
1,1-Dichloropropene	nd	nd	nd	nd	nd	nd	0.25
1,2,3-Trichlorobenzene	nd	nd	nd	nd	nd	nd	0.25
1,2,3-Trichloropropane	nd	nd	nd	nd	nd	nd	0.25
1,2,4-Trichlorobenzene	nd	nd	nd	nd	nd	nd	0.25
1,2,4-Trimethylbenzene	nd	nd	nd	nd	nd	nd	0.25
1,2-Dibromo-3-chloropropane	nd	nd	nd	nd	nd	nd	0.25
1,2-Dibromoethane (EDB)	nd	nd	nd	nd	nd	nd	0.25
1,2-Dichlorobenzene	nd	nd	nd	nd	nd	nd	0.25
1,2-Dichloroethane	nd	nd	nd	nd	nd	nd	0.25
1,2-Dichloropropane	nd	nd	nd	nd	nd	nd	0.25
1,3,5-Trimethylbenzene	nd	nd	nd	nd	nd	nd	0.25
1,3-Dichlorobenzene	nd	nd	nd	nd	nd	nd	0.25
1,3-Dichloropropane	nd	nd	nd	nd	nd	nd	0.25
1,3-Dimethyl adamantane	nd	nd	nd	nd	nd	nd	0.25
1,4-Dichlorobenzene	nd	nd	nd	nd	nd	nd	0.25
2,2-Dichloropropane	nd	nd	nd	nd	nd	nd	0.25
2-Butanone	-----	-----	-----	nd	0.64	0.82	0.50
2-Chlorotoluene	nd	nd	nd	nd	nd	nd	0.25
4-Chlorotoluene	nd	nd	nd	nd	nd	nd	0.25
4-Methyl-2-pentanone	-----	-----	-----	nd	nd	nd	0.25
2-Hexanone	-----	-----	-----	nd	0.29	0.41	0.25
Acetone	-----	-----	-----	nd	1.03	1.38	1.00
Acrylonitrile	nd	nd	nd	nd	nd	nd	0.25
Adamantane	nd	nd	nd	nd	nd	nd	0.25
Allyl chloride	nd	nd	nd	nd	nd	nd	0.25
Benzene	nd	nd	nd	nd	nd	nd	0.03
Bromobenzene	nd	nd	nd	nd	nd	nd	0.25
Bromochloromethane	nd	nd	nd	nd	nd	nd	0.25
Bromodichloromethane	nd	nd	nd	nd	nd	nd	0.25
Bromoform	nd	nd	nd	nd	nd	nd	0.25
Bromomethane	nd	nd	nd	nd	nd	nd	0.25
Carbon disulfide	nd	nd	nd	nd	nd	nd	0.25
Carbon tetrachloride	nd	nd	nd	nd	nd	nd	0.25
Chlorobenzene	nd	nd	nd	nd	nd	nd	0.25
Chlorodibromomethane	nd	nd	nd	nd	nd	nd	0.25
Chloroethane	nd	0.25	nd	nd	nd	nd	0.25
Chloroform	nd	nd	nd	nd	nd	nd	0.25
Chloromethane	nd	nd	nd	1.04	nd	nd	0.25
cis-1,2-Dichloroethene	nd	nd	nd	nd	nd	nd	0.25
cis-1,3-Dichloropropene	nd	nd	nd	nd	nd	nd	0.25
Dibromomethane	nd	nd	nd	nd	nd	nd	0.25
Dichlorodifluoromethane	nd	nd	nd	nd	nd	nd	0.25
Ethyl Ether	nd	nd	nd	nd	nd	nd	0.25
Ethylbenzene	nd	nd	nd	nd	nd	nd	0.25
Hexachlorobutadiene	nd	nd	nd	nd	nd	nd	0.25
Hexachloroethane	nd	nd	nd	nd	nd	nd	0.25
Iodomethane	nd	nd	nd	nd	nd	nd	0.25
Isopropylbenzene	nd	nd	nd	nd	nd	nd	0.25
m,p-Xylene	nd	nd	nd	nd	0.69	0.70	0.50
Methacrylonitrile	nd	nd	nd	nd	0.27	nd	0.25

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	Trip Blank	EQ Blank	Field Blank	Trip Blank	Field Blank	Field Blank	RL
	10/6/2010	10/7/2010	10/5/2010	4/14/2011	4/18/2011	4/21/2011	
Methyl Acrylate	nd	nd	nd	nd	nd	nd	0.25
Methyl tert-Butyl Ether	nd	nd	nd	nd	nd	nd	0.25
Methylene chloride	nd	nd	nd	nd	nd	nd	0.25
Naphthalene	nd	nd	nd	nd	nd	nd	0.25
n-Butyl Benzene	nd	nd	nd	nd	nd	nd	0.25
n-Propyl Benzene	nd	nd	nd	nd	nd	nd	0.25
o-Xylene	nd	nd	nd	nd	nd	nd	0.25
p-Isopropyltoluene	nd	nd	nd	nd	nd	nd	0.25
sec-Butylbenzene	nd	nd	nd	nd	nd	nd	0.25
Styrene	nd	nd	nd	nd	nd	nd	0.25
tert-Butylbenzene	nd	nd	nd	nd	nd	nd	0.25
Tetrachloroethene	nd	nd	nd	nd	nd	nd	0.25
Toluene	0.54	0.16	0.16	nd	nd	nd	0.25
trans-1,2-Dichloroethene	nd	nd	nd	nd	nd	nd	0.25
trans-1,3-Dichloropropene	nd	nd	nd	nd	nd	nd	0.25
Trichloroethene	nd	nd	nd	nd	nd	nd	0.25
Trichlorofluoromethane	nd	nd	nd	nd	nd	nd	0.25
Vinyl chloride	nd	nd	nd	nd	nd	nd	0.25
Xylenes (total)	nd	nd	nd	nd	nd	nd	0.75

RL – Reporting Limit (µg/L). nd – not detected. ----- not measured.

Table B10. Blank results for Volatile Organic Compounds (µg/L) in Phase IV sampling (ORD laboratory, Ada, OK)

	Trip Blank	Field Blank	Field Blank	MDL	QL
	4/14/2011	4/18/2011	4/21/2011		
Vinyl chloride	nd	nd	nd	0.14	1.0
1,1-Dichloroethene	nd	nd	nd	0.07	0.5
Methylene Chloride	nd	nd	nd	0.19	0.5
trans-1,2-Dichloroethene	nd	nd	nd	0.05	0.5
cis-1,2-Dichloroethene	nd	nd	nd	0.15	0.5
Chloroform	nd	nd	nd	0.07	0.5
1,1,1-Trichloroethane	nd	nd	nd	0.03	0.5
Carbon Tetrachloride	nd	nd	nd	0.04	0.5
1,2-Dichloroethane	nd	nd	nd	0.03	0.5
Trichloroethene	nd	nd	nd	0.07	0.5
1,1,2-Trichloroethane	nd	nd	nd	0.03	0.5
Tetrachloroethene	nd	nd	nd	0.09	0.5
Chlorobenzene	nd	nd	nd	0.04	0.5
1,3-Dichlorobenzene	nd	nd	nd	0.06	0.5
1,4-Dichlorobenzene	nd	nd	nd	0.04	0.5
1,2-Dichlorobenzene	nd	nd	nd	0.03	0.5
Ethanol	nd	nd	nd	0.11	1.0
Isopropanol	nd	nd	nd	24.7	100
n-Propanol	nd	nd	nd	11.4	100
Isobutanol	nd	nd	nd	13.5	100
n-Butanol	nd	nd	nd	15.6	100
tert-Butyl Alcohol	nd	nd	nd	15.5	100
Methyl tert-Butyl Ether	nd	nd	nd	1.72	5.0
di-Isopropyl Ether	nd	nd	nd	0.11	0.5
Ethyl tert-Butyl Ether	nd	nd	nd	0.11	0.5
Benzene	nd	nd	nd	0.03	0.5
tert-Amyl Methyl Ether	nd	nd	nd	0.06	0.5
2,5-Dimethylfuran	nd	nd	nd	0.06	0.5
Toluene	BQL 0.228	nd	BQL 0.227	0.03	0.5
1,2-Dibromoethane	nd	nd	nd	0.03	0.5
Ethyl Benzene	nd	nd	nd	0.09	1.0
m+p Xylene	BQL 0.229	nd	BQL 0.133	0.03	0.5
o-Xylene	nd	nd	nd	0.08	0.5
1,3,5-Trimethylbenzene	nd	nd	nd	0.03	0.5
1,2,4-Trimethylbenzene	nd	nd	nd	0.04	1.0
1,2,3-Trimethylbenzene	nd	nd	nd	0.02	1.0
Naphthalene	nd	nd	nd	0.04	1.0

All results in µg/L. MDL – method detection level. QL – quantitation level. nd – not detected.

Table B11. Blank results for Semi-Volatile Organic Compounds (µg/L) in Phase III and Phase IV sampling (Region 8 laboratory, Golden, CO)

	Trip Blank	EQ Blank	Field Blank	Trip Blank	Field Blank	Field Blank	RL
	10/6/2010	10/7/2010	10/5/2010	4/14/2011	4/18/2011	4/21/2011	
1,2,4-Trichlorobenzene	nd	nd	nd	nd	nd	nd	0.100
1,2-Dichlorobenzene	nd	nd	nd	nd	nd	nd	0.100
1,2-Dinitrobenzene	nd	nd	nd	nd	nd	nd	0.100
1,3-Dichlorobenzene	nd	nd	nd	nd	nd	nd	0.100
1,3-Dinitrobenzene	nd	nd	nd	nd	nd	nd	0.100
1,4-Dichlorobenzene	nd	nd	nd	nd	nd	nd	0.100
1,4-Dinitrobenzene	nd	nd	nd	nd	nd	nd	0.100
1-Methylnaphthalene	nd	nd	nd	nd	nd	nd	0.100
2,3,4,6-Tetrachlorophenol	nd	nd	nd	nd	nd	nd	0.250
2,3,5,6-Tetrachlorophenol	nd	nd	nd	nd	nd	nd	0.250
2,4,5-Trichlorophenol	nd	nd	nd	nd	nd	nd	0.100
2,4,6-Trichlorophenol	nd	nd	nd	nd	nd	nd	0.100
2,4-Dichlorophenol	nd	nd	nd	nd	nd	nd	0.100
2,4-Dimethylphenol	nd	nd	nd	nd	nd	nd	0.100
2,4-Dichlorophenol	nd	nd	nd	nd	nd	nd	0.100
2,4-Dimethylphenol	nd	nd	nd	nd	nd	nd	0.100
2,4-Dinitrophenol	nd	nd	nd	nd	nd	nd	1.00
2,4-Dinitrotoluene	nd	nd	nd	nd	nd	nd	1.00
2,6-Dinitrotoluene	nd	nd	nd	nd	nd	nd	0.100
2-Chloronaphthalene	nd	nd	nd	nd	nd	nd	0.100
2-Chlorophenol	nd	nd	nd	nd	nd	nd	0.100
2-Methylnaphthalene	nd	nd	nd	nd	nd	nd	0.100
2-Methylphenol	nd	nd	nd	nd	nd	nd	0.100
2-Nitroaniline	nd	nd	nd	nd	nd	nd	0.100
2-Nitrophenol	nd	nd	nd	nd	nd	nd	0.100
3 & 4-Methylphenol	nd	nd	nd	nd	nd	nd	0.200
3,3´-Dichlorobenzidine	nd	nd	nd	nd	nd	nd	0.500
3-Nitroaniline	nd	nd	nd	nd	nd	nd	0.100
4,6-Dinitro-2-methylphenol	nd	nd	nd	nd	nd	nd	0.500
4-Bromophenyl phenyl ether	nd	nd	nd	nd	nd	nd	0.100
4-Chloro-3-methylphenol	nd	nd	nd	nd	nd	nd	0.100
4-Chloroaniline	nd	nd	nd	nd	nd	nd	0.100
4-Chlorophenyl phenyl ether	nd	nd	nd	nd	nd	nd	0.100
4-Nitroaniline	nd	nd	nd	nd	nd	nd	0.500
4-Nitrophenol	nd	nd	nd	nd	nd	nd	1.00
Acenaphthene	nd	nd	nd	nd	nd	nd	0.100
Acenaphthylene	nd	nd	nd	nd	nd	nd	0.100
Aniline	nd	nd	nd	nd	nd	nd	0.100
Anthracene	nd	nd	nd	nd	nd	nd	0.100
Azobenzene	nd	nd	nd	nd	nd	nd	0.100
Benzo (a) anthracene	nd	nd	nd	nd	nd	nd	0.100
Benzo (a) pyrene	nd	nd	nd	nd	nd	nd	0.100
Benzo (g,h,i) perylene	nd	nd	nd	nd	nd	nd	0.100
Benzo (k) fluoranthene	nd	nd	nd	nd	nd	nd	0.100
Benzo(b)fluoranthene	nd	nd	nd	nd	nd	nd	0.100
Benzoic acid	0.83	0.78	nd	3.00	nd	nd	0.500
Benzyl alcohol	nd	0.40	0.63	nd	nd	nd	0.500
Bis(2-chloroethoxy)methane	nd	nd	nd	nd	nd	nd	0.100
Bis(2-chloroethyl)ether	nd	nd	nd	nd	nd	nd	0.100
Bis(2-chloroisopropyl)ether	nd	nd	nd	nd	nd	nd	0.100
Bis-(2-Ethylhexyl) Adipate	nd	nd	nd	nd	nd	nd	0.100
Bis(2-ethylhexyl)phthalate	nd	nd	nd	5.44	nd	nd	0.500
Butyl benzyl phthalate	nd	nd	nd	nd	nd	nd	0.100
Carbazole	nd	nd	nd	nd	nd	nd	0.100
Chrysene	nd	nd	nd	nd	nd	nd	0.100
Dibenz (a,h) anthracene	nd	nd	nd	nd	nd	nd	0.100

	Trip Blank	EQ Blank	Field Blank	Trip Blank	Field Blank	Field Blank	RL
	10/6/2010	10/7/2010	10/5/2010	4/14/2011	4/18/2011	4/21/2011	
Dibenzofuran	nd	nd	nd	nd	nd	nd	0.100
Diethyl phthalate	nd	nd	nd	nd	nd	nd	0.100
Dimethyl phthalate	nd	nd	nd	nd	nd	nd	0.100
Di-n-butyl phthalate	nd	nd	nd	nd	nd	nd	0.100
Di-n-octyl phthalate	nd	nd	nd	nd	nd	nd	0.100
Diphenylamine	nd	nd	nd	nd	nd	nd	0.100
Fluoranthene	nd	nd	nd	nd	nd	nd	0.100
Fluorene	nd	nd	nd	nd	nd	nd	0.100
Hexachlorobenzene	nd	nd	nd	nd	nd	nd	0.100
Hexachlorobutadiene	nd	nd	nd	nd	nd	nd	0.100
Hexachlorocyclopentadiene	nd	nd	nd	nd	nd	nd	0.100
Hexachloroethane	nd	nd	nd	nd	nd	nd	0.100
Indeno (1,2,3-cd) pyrene	nd	nd	nd	nd	nd	nd	0.100
Isophorone	nd	nd	nd	nd	nd	nd	0.100
Naphthalene	nd	nd	nd	nd	nd	nd	0.100
Nitrobenzene	nd	nd	nd	nd	nd	nd	0.100
N-Nitrosodi-n-propylamine	nd	nd	nd	nd	nd	nd	0.100
Pentachlorophenol	nd	nd	nd	nd	nd	nd	0.500
Phenanthrene	nd	nd	nd	nd	nd	nd	0.100
Phenol	nd	nd	nd	nd	nd	nd	0.100
Pyrene	nd	nd	nd	nd	nd	nd	0.100
Limonene	nd	nd	nd	nd	nd	nd	0.100
1,3-Dimethyl adamantane	nd	nd	nd	nd	nd	nd	0.100
2-Butoxyethanol	nd	nd	nd	nd	nd	nd	0.100
Adamantane	nd	0.32	nd	nd	nd	nd	0.100
Squalene	0.36	0.49	0.23	nd	nd	nd	1.00
Terpiniol	nd	nd	nd	nd	nd	nd	0.100
Tri(2-butoxyethyl) Phosphate	nd	2.53	nd	nd	nd	nd	0.500

RL – Reporting Limit (µg/L). nd – not detected. ----- not measured.

Table B12. Blank results for GRO and DRO analyses for Phase III and Phase IV sampling (Region 8 laboratory, Golden, CO) and blank results for glycol ethers in Phase IV sampling (Region 3 laboratory, Fort Meade, MD)

	Trip Blank	EQ Blank	Field Blank	Trip Blank	Field Blank	Field Blank	RL
	10/6/2010	10/7/2010	10/5/2010	4/14/2011	4/18/2011	4/21/2011	
Gasoline Range Organics	nd	nd	nd	nd	21.3	nd	20
Diesel Range Organics	nd	nd	nd	nd	nd	135	22
2-Butoxyethanol	-----	-----	-----	nd	nd	nd	10
Diethylene Glycol	-----	-----	-----	nd	nd	nd	50
Triethylene Glycol	-----	-----	-----	nd	nd	nd	10
Tetraethylene Glycol	-----	-----	-----	3.6	3.1	3.4	10

RL – Reporting Limit (µg/L). nd – not detected. ----- not measured.

Table B13. Duplicate data for selected major ions, DOC, and DIC in ground water samples collected during Phase III and Phase IV sampling activities

Sample	Date	Na	K	Ca	Mg	Ba	Sr	Si	Cl	SO4	F	NO3	DOC	DIC
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
LD01	10/6/2010	562	1.05	71.9	8.12	0.0096	1.08	5.82	33.0	1320	0.90	0.354	0.568	17.8
LD01 dup	10/6/2010	565	0.97	71.9	8.14	0.0096	1.08	5.81	32.9	1320	0.99	0.337	0.558	17.2
RPD		0.53	7.92	0.00	0.25	0.00	0.00	0.17	0.30	0.00	9.52	4.92	1.78	3.48
PGDW32	4/18/2011	198	0.09	7.19	0.028	0.010	0.090	6.74	18.8	361	1.95	ND	0.41	7.70
PGDW32 dup	4/18/2011	198	0.27	7.28	0.026	0.009	0.090	6.80	19.1	349	2.02	ND	0.37	7.73
RPD		0.00	100	1.24	7.41	10.53	0.00	0.89	1.58	3.38	3.53	NC	10.26	0.39
EPAMW02	4/19/2011	448	43.6	60.5	0.032	0.093	1.78	2.94	457	62.6	1.54	ND	19.7	1.40
EPAMW02 dup	4/19/2011	449	44.0	60.5	0.019	0.093	1.79	2.93	456	62.5	1.49	ND	19.7	1.39
RPD		0.22	0.91	0.00	50.98	0.00	0.56	0.34	0.22	0.16	3.30	NC	0.00	0.72

RPD is the calculated relative percent difference: RPD = |[(sample1-sample2)/((sample1+sample2)/2)]*100|. ND – not detected. ----- not measured. NC – not calculated.

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Table B14. Duplicate data for methane and selected dissolved organic compounds in ground water samples collected during Phase III and Phase IV sampling activities

Sample	Date	Methane	Benzene	Toluene	m,p-Xylenes	Isopropyl alcohol	Tert-butyl alcohol	Phenol	Diethylene Glycol	Triethylene Glycol	Acetone
		ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
LD01	10/6/2010	0.189	<0.25	<0.25	<0.25	-----	-----	<0.1	-----	-----	-----
LD01 dup	10/6/2010	0.168	<0.25	<0.25	<0.25	-----	-----	<0.1	-----	-----	-----
RPD		11.76	NC	NC	NC	NC	NC	NC	NC	NC	NC
PGDW32	4/18/2011	0.07	<0.25	<0.25	<0.25	<11.4	<1.7	<0.5	<50	<10	<1.00
PGDW32 dup	4/18/2011	0.06	<0.25	<0.25	<0.25	<11.4	<1.7	<0.5	<50	<10	<1.00
RPD		15.38	NC	NC	NC	NC	NC	NC	NC	NC	NC
EPAMW02	4/19/2011	18.82	139	336	280	581	4470	14.5	1570	314	641
EPAMW02 dup	4/19/2011	22.62	164	424	354	553	4580	29.2	1610	293	616
RPD		18.34	16.50	23.16	23.34	4.94	2.43	67.28	2.52	6.92	3.98

RPD is the calculated relative percent difference: RPD = |[(sample1-sample2)/((sample1+sample2)/2)]*100|. ND – not detected. ----- not measured. NC – not calculated.

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Table B15. QA/QC requirements for analysis of $\delta^{13}C$ of DIC

QC Type	Performance Criteria	Frequency
Mass Spec Calibration Check	Difference of calibrated/true $\leq$ 0.5‰	One at beginning of day, and one after sample is analyzed.
Mass Spec Zero Enrichment Check	0 +/- 0.1 ‰	Once a day
Lab Duplicates	$\leq$ 1 ‰	1 per every 5 samples*

Working standards were calibrated against IAEA (International Atomic Energy Agency) standard LSVEC and NBS-19; referenced to $\delta^{13}C$ of the PeeDee belemnite (NIST material).
*If < 5 samples were submitted, a duplicate was run regardless of total number.
Corrective Actions: If re-analysis was not possible (such as lack of sample volume), the data was qualified with a determination about the impact on the sample data.

Table B16. QA/QC requirements for analysis for $\delta^{13}C$ and δD of light hydrocarbons for aqueous and gas samples

QC Type	Performance Criteria	Frequency
Mass Spec Calibration Check	Difference of calibrated/true $\leq$ 0.5‰ for $\delta^{13}C$ and $\leq$ 3‰ for δD +/- 1 pMC for ^{14}C	One at beginning of day and after samples are analyzed for $\delta^{13}C$*; one at beginning of day and every tenth sample for δD**
Mass Spec Zero Enrichment Check	0 +/- 0.1 ‰ for $\delta^{13}C$ and 0 +/- 1 ‰ for δD	Once a day for $\delta^{13}C$ and every tenth sample for δD
Lab Duplicates	$\leq$ 1 ‰ for $\delta^{13}C$ and $\leq$ 3‰ for δD +/- 1 pMC for ^{14}C	1 per every 10 samples for $\delta^{13}C$ and δD ***
Preparation System Check/Reference Standards	$\leq$ 1 ‰ for $\delta^{13}C$ and $\leq$ 3‰ for δD +/- 1 pMC	One per every 10 samples for $\delta^{13}C$ and δD

*Working standards calibrated against IAEA (International Atomic Energy Agency) standard LSVEC and NBS-19; referenced to $\delta^{13}C$ of the PeeDee belemnite (NIST material).
**Working standards calibrated against VSMOW, SLAP, and GISP; referenced to VSMOW.
***If < 10 samples were submitted, duplicate run regardless of total number.
Corrective Actions: If re-analysis is not possible (such as lack of sample volume), the data will be qualified with a determination about the impact on the sample data.

Table B17. QA/QC requirements for analysis of fixed gases and light hydrocarbons for aqueous and gas samples

Measurement	Analysis Method	Blanks (Frequency)	Calibration Checks (Frequency)	Second Source (Frequency)	Duplicates (Frequency)	Matrix Spikes (Frequency)
Ar, He, H_2, O_2, N_2, CO_2, CH_4, C_2H_6, C_2H_4, C_3H_6, C_3H_8, iC_4H_{10}, nC_4H_{10}, iC_5H_{12}, nC_5H_{12}, C_6+	Modification of ASTM D1945-03	None Detected (beginning every 10 samples, end of run)	85-115% (beginning every 10 samples, end of run)	85-115% (after each calibration)	RPD <15% (every 10 samples)	NA

Table B18. Summary of quality control samples, purpose, method, and frequency to support gas analysis				
QC Sample	**Purpose**	**Method**	**Frequency**	**Acceptance Criteria**
Equipment Blanks	Ensure that construction materials in gas sample bags and the sample train are not a source of vapors or gases of concern	Fill sample bags with ultrapure N_2 gas via the sample train.	One sample per day	< Detection limit
Travel Blanks	Ensure that cross-contamination does not occur during sampling or transport to the laboratory	Fill sample bags with ultrapure N_2 gas and place in shipping container with other samples.	One sample per shipment	< Detection limit
Duplicates	Check precision of sampling method and analysis	Use a tee to collect two samples simultaneously.	One sample every 10 samples	RPD < 20%

Table B19. Summary of analytes, instruments, calibration, and check standards for portable gas analyzers						
Analyte	**Instrument (Detector)**	**Method**	**Range**	**Calibration**	**Check Standard**	**Accuracy**
O_2	GEM-2000 Plus CES-LANDTEC (EC Cell)	RSKSOP-314v1	0 - 21%	4%, 10%, or 20.9%	4% 10%, 20.9%	±1.0% (0-5%) ±1.0% (5-21%)
CH_4	GEM-2000 Plus CES-LANDTEC (IRGA)	RSKSOP-314v1	0 - 100%	2.5% or 50%	2.5%, 50%	±0.3% (0-5%) ±1% (5-15%) ±3% (15-100%)
CO_2	GEM-2000 Plus CES-LANDTEC (IRGA)	RSKSOP-314v1	0 - 100%	5%, 20%, or 35%	5%, 20%, 35%	±0.3% (0-5%) ±1.0% (5-15%) ±3.0% (15-50%)
VOCs	Thermo Scientific TVA-1000B (FID)	RSKSOP-320v1	1.0 – 10,000 ppmv	0.0, 10, 100, 1000, 9000 ppmv CH_4	10, 100, 1000, 9000 ppmv CH_4	±25% or ±2.5 ppmv, whichever is greater, from 1.0 to 10,000 ppmv.
VOCs	Thermo Scientific TVA-1000B (PID)	RSKSOP-320v1	0.5 – 500 ppmv	0.0, 250, 475 ppmv	250, 475 ppmv Isobutylene	±25% or ±2.5 ppmv, whichever is greater, from 0.5 to 500 ppmv.

Table B20. QA/QC Requirements for portable gas analyzers				
Measurement	**Analysis Method**	**Blanks** (Frequency)**	**Calibration Check Standards (Frequency)**	**Second Source Standards (Frequency)**
O_2, CO_2, CH_4,	RSKSOP-314v1	beginning & end of each sample event)	+/-1% of reading (beginning & end of each sample event)	+/-1% of reading (after each calibration, optional for this project)
Hydrocarbons	RSKSOP-320v1	beginning & end of each sample event)	90-110% of known value for FID and 80-120% for PID (after calibration, beginning & end of each sample event)	NA

Corrective actions are detailed in the SOPs.
*Duplicate sample not appropriate for measurements from a sample train.
**Meter reading

Appendix C

Photographic Log of Deep Monitoring Well Construction

Figure C1. Photograph of drilling rig on platform with shakers for mud recirculation at MW02.

Figure C2. Photograph of blowout prevention (BOP) for annular space at base of drilling rig platform at MW02.

Figure C3. Photograph of blowout preventer for drillstem.

Figure C4. Photograph of bit and drillstem with bit for mud rotary drilling at MW02.

Figure C5. Photograph of water truck used to transport water to mix mud.

Figure C6. Photograph of Quik-Gel bentonite (Halliburton) used to create mud for drilling.

Figure C7. Photograph of mud additives EZ Mud Gold (Halliburton) and Dense Soda Ash.

Figure C8. Photograph of mud additive Penetrol (Halliburton).

Figure C9. Photograph of flow of mud and cuttings from borehole at MW02.

Figure C10. Photograph of monitoring of mud and cuttings using a Thermo Scientific TVA-1000B FID/PID at MW02.

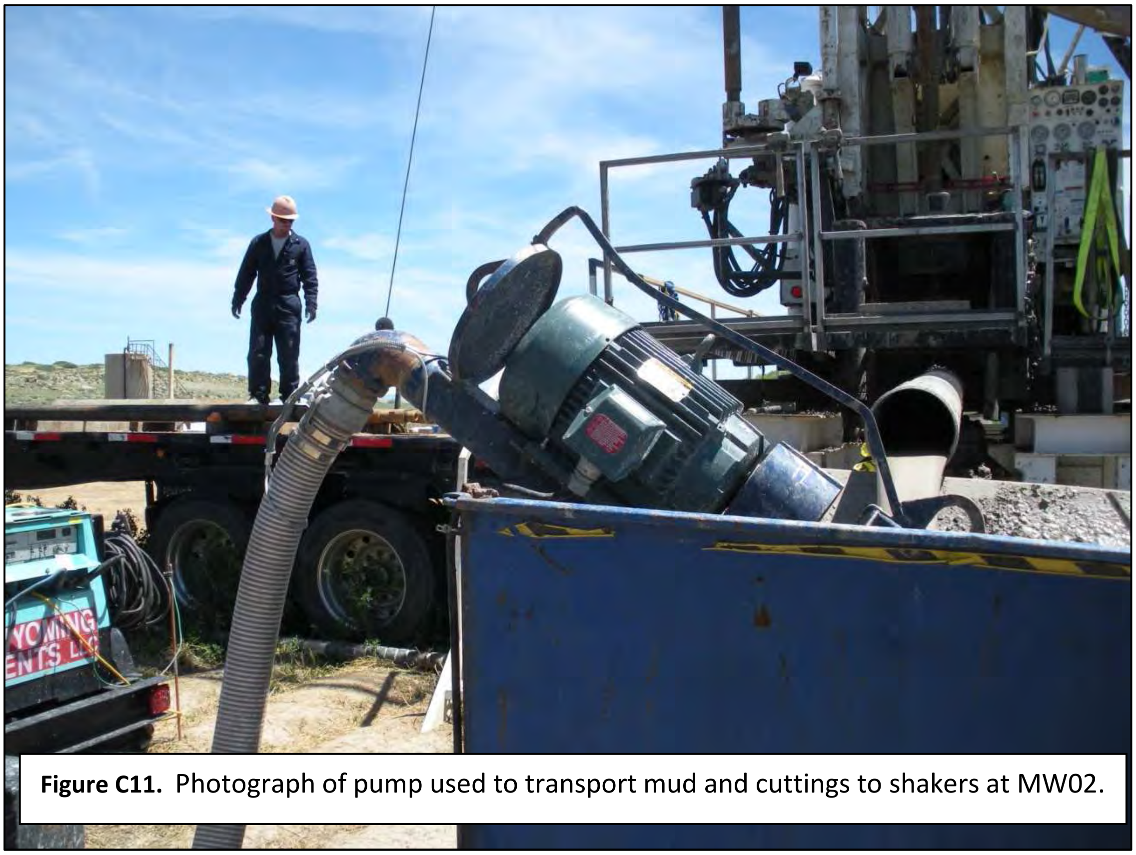

Figure C11. Photograph of pump used to transport mud and cuttings to shakers at MW02.

Figure C12. Photograph of flow of mud and cuttings to shakers at MW02.

Figure C13. Photograph of shakers separating mud from cuttings at MW02.

Figure C14. Photograph of cuttings transported to disposal bins at MW02.

Figure C15. Photograph of pumping of mud back to borehole at MW02.

Figure C16. Photograph of injection of mud to borehole at MW02.

Figure C17. Photograph of collection of cuttings for lithologic characterization at MW02.

Figure C18. Photograph of removal of mud from cuttings at MW02.

Figure C19. Photograph of white coarse-grained sand targeted by local well drillers and media in which screens are set in for both deep monitoring wells.

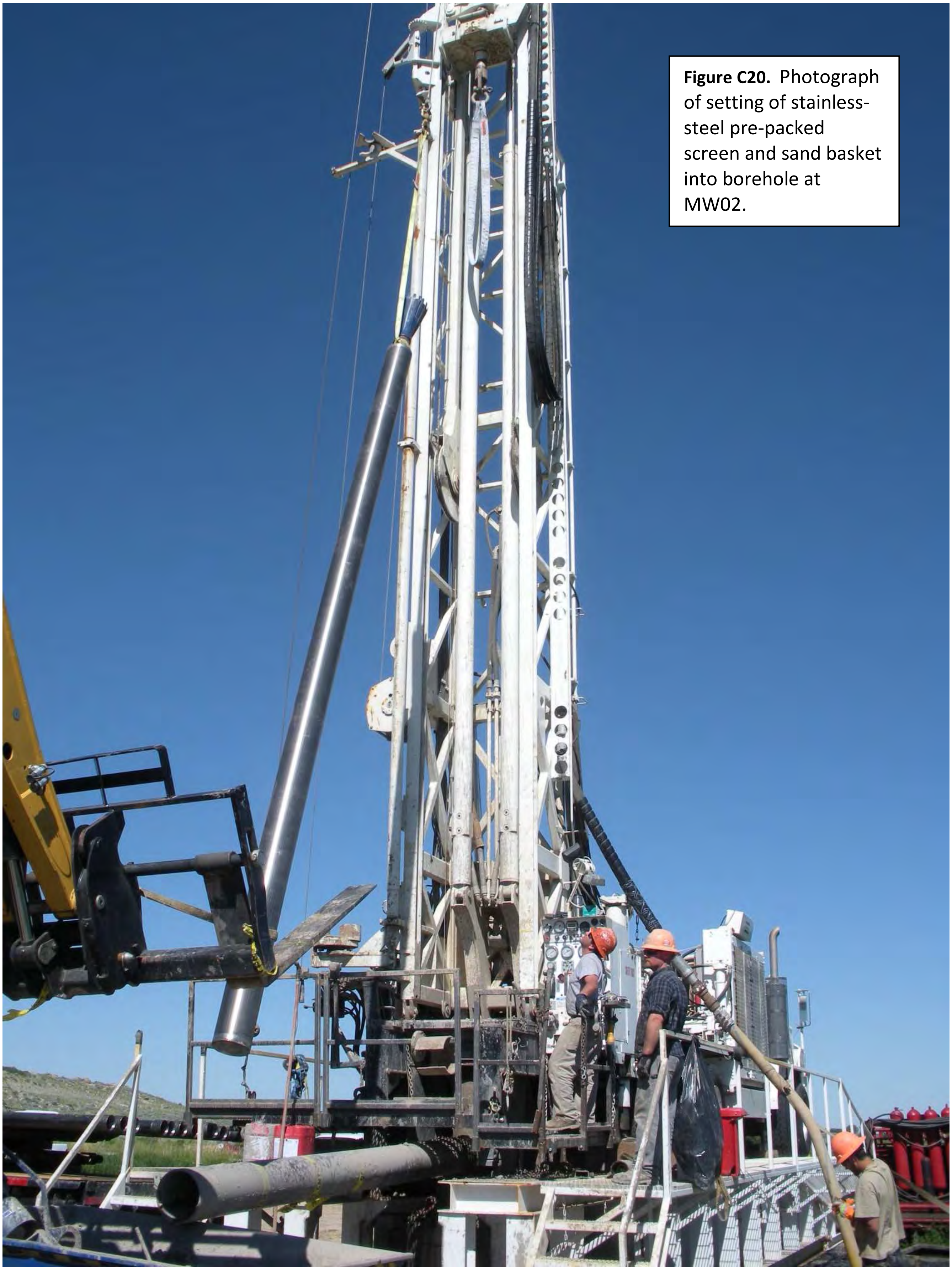

Figure C20. Photograph of setting of stainless-steel pre-packed screen and sand basket into borehole at MW02.

Figure C21. Photograph of securing sand basket and casing above screen.

Figure C22. Photograph of placement of sand in sandbasket.

Figure C23. Photograph of well development at MW02.

Appendix D

Photographic Log of Ground Water Sampling

Figure D1. Photograph of flow from submersible pump through flowmeter at MW02.

Figure D2. Photograph of flow of water to purge water disposal tank at MW02.

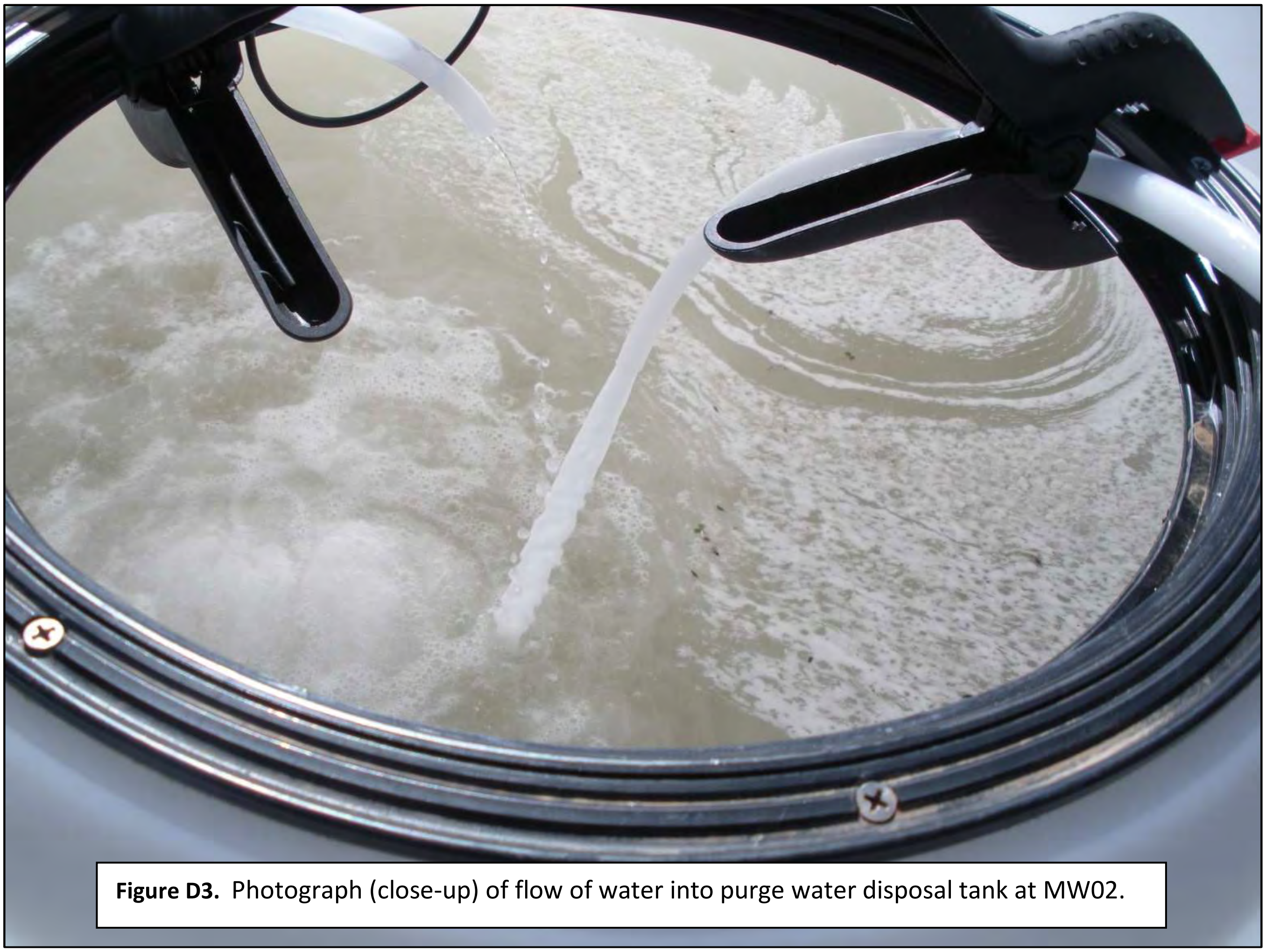

Figure D3. Photograph (close-up) of flow of water into purge water disposal tank at MW02.

Figure D4. Photograph of water (foaming) flowing into YSI flow cell at MW02.

Figure D5. Photograph of sampling at MW02. The sample train was split prior to entry into purge water disposal container.

Figure D6. Photograph of field filtering samples for metals analysis at MW02.

Figure D7. Photograph of sample collection at PGDW14.

Figure D8. Photograph of cooler packed with samples for shipment.

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Appendix E

Examples of Cement Bond/Variable Density Log Interpretation

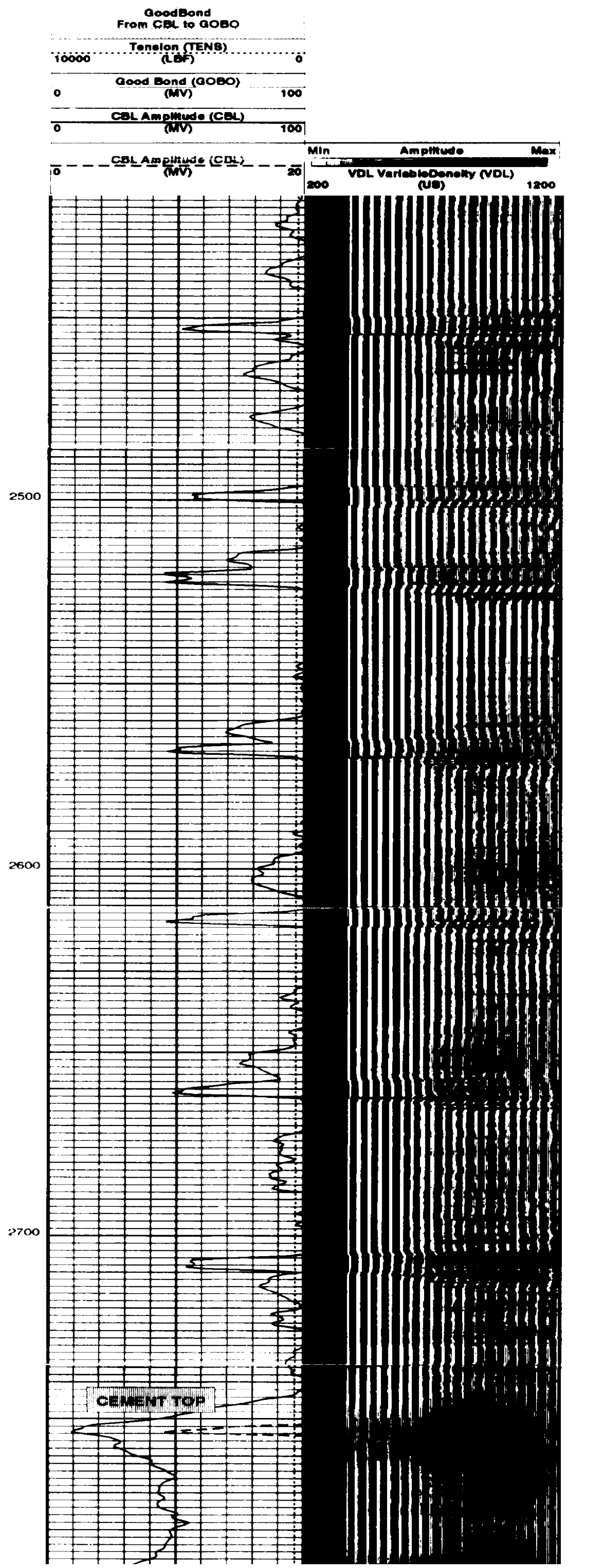

Figure E1. Example of CBL/VDL indicating "no cement" at Pavillion Fee 34-03B. The CBL/VDL indicates no cement 2750 feet below ground surface at the time of logging.

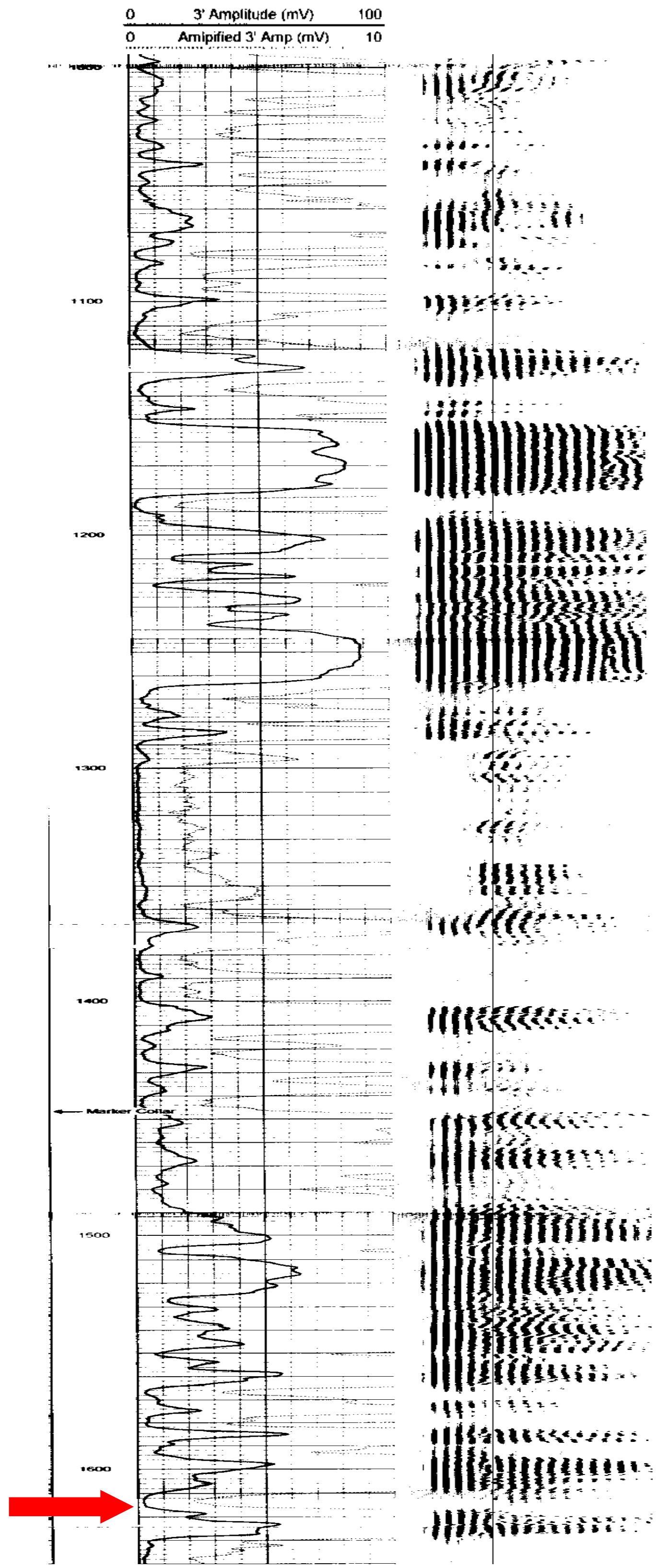

Figure E2. Example of "sporadic bonding" at Pavillion Fee 41-10 from 1000 to 1640 ft bgs. Hydraulic fracturing occurred at 1618 feet below ground surface. Arrow denotes interval of hydraulic fracturing.

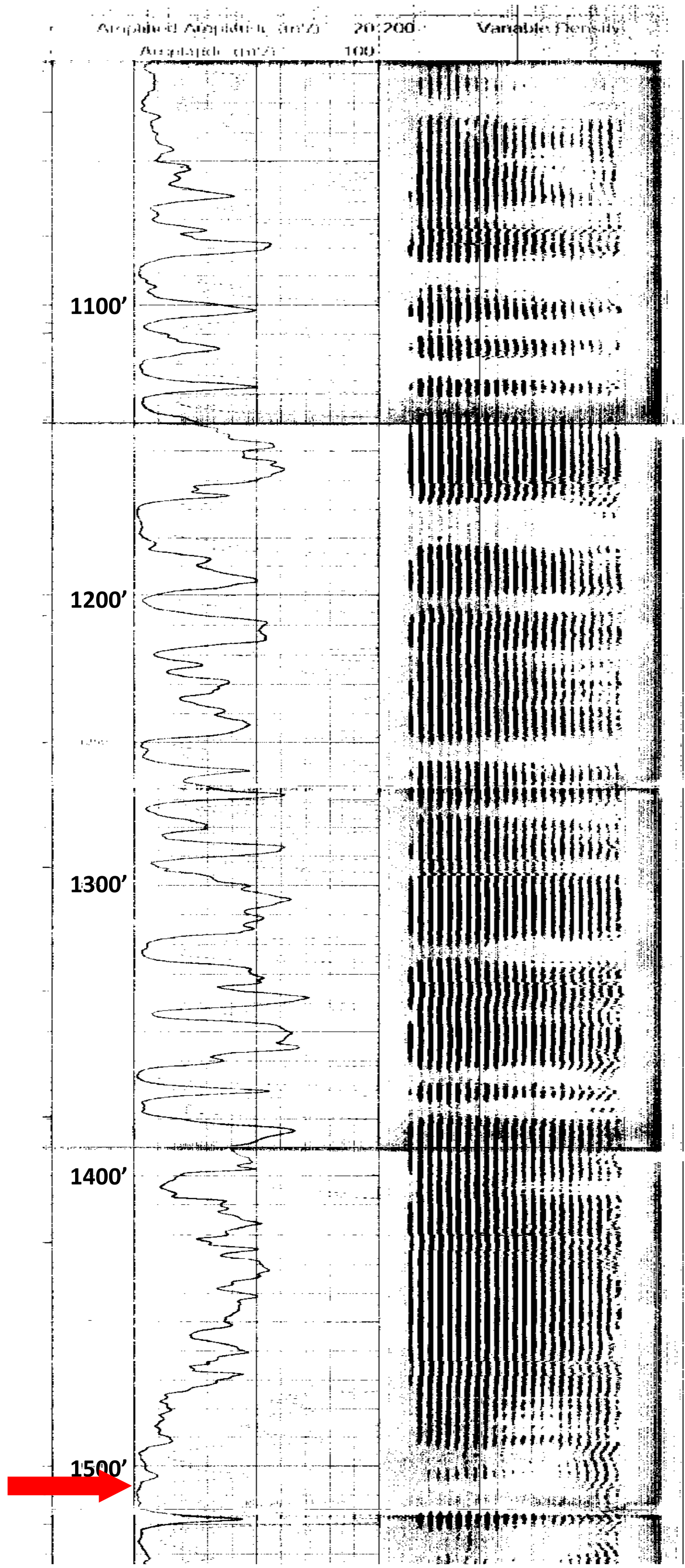

Figure E3a. Example of "sporadic bonding" at Pavillion Fee 11-11B. Hydraulic fracturing occurred at 1516 feet below ground surface. Arrow denotes interval of hydraulic fracturing. Depths on CBL/VDL difficult to read and inserted on left margin.

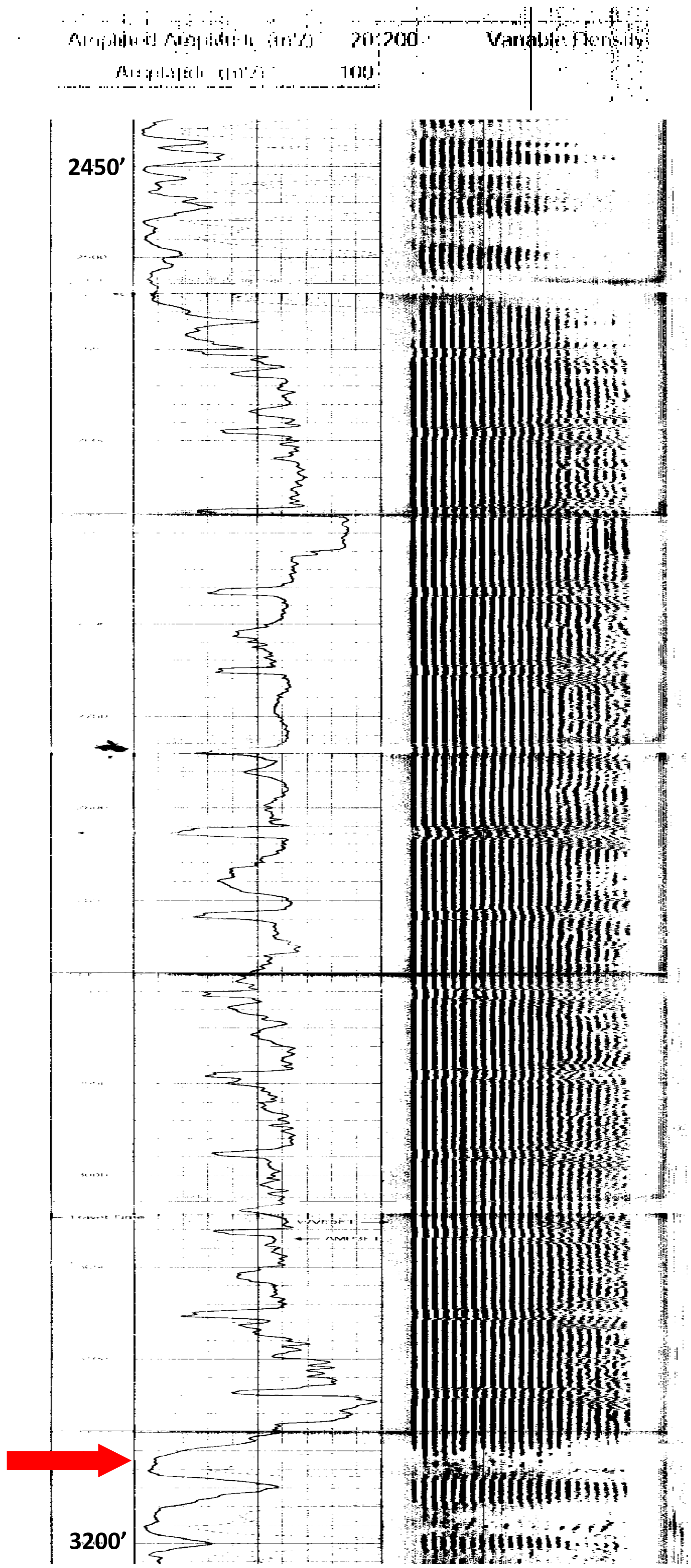

Figure E3b. Example of "sporadic bonding" Pavillion Fee 11-11B between 2350-3200 feet below ground suface. Hydraulic fracturing occurred at 3165 feet below ground surface. Arrow denotes interval of hydraulic fracturing. Depths on CBL/VDL difficult to read and inserted on left margin.

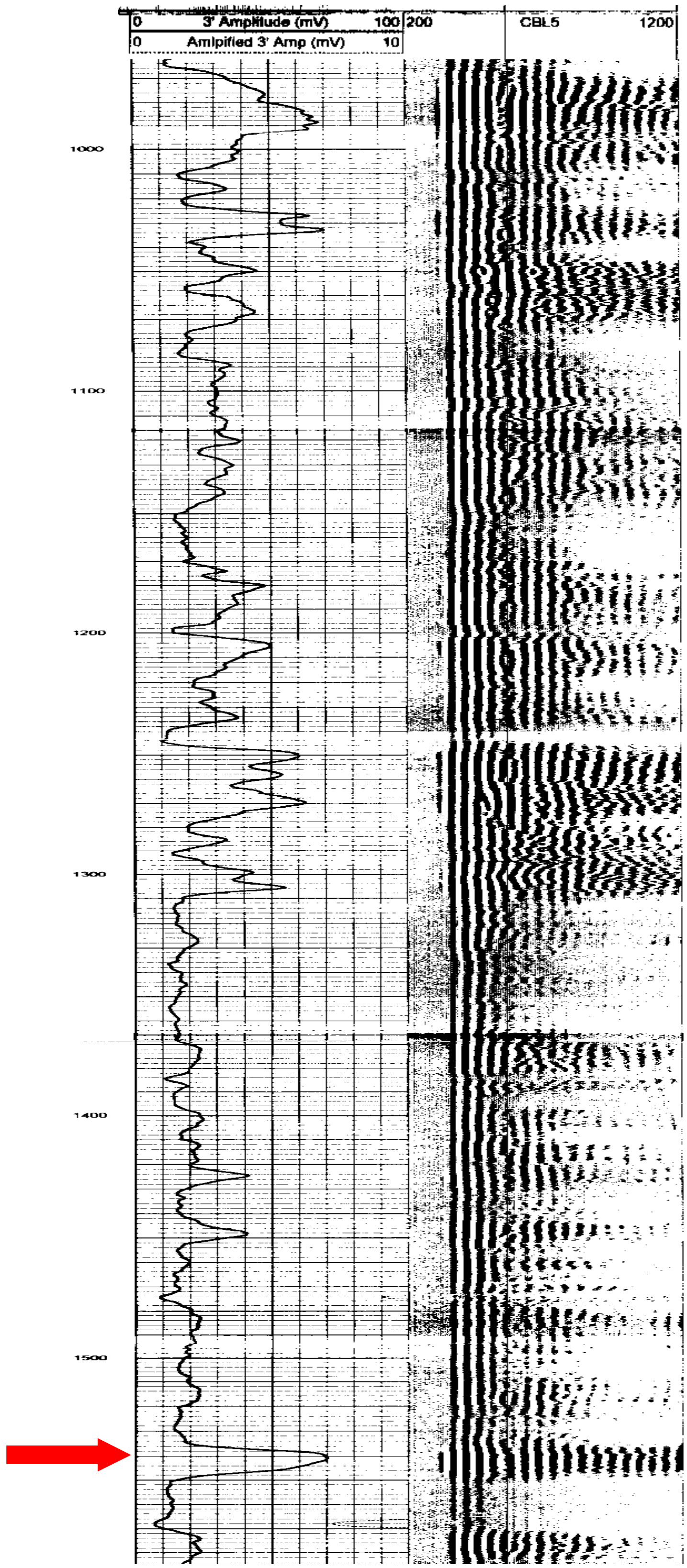

Figure E4. Example of "Sporadic Bonding" at Tribal Pavillion 24-02. Hydraulic fracturing occurred at 1538 feet bgs. Arrow denotes interval of hydraulic fracturing.

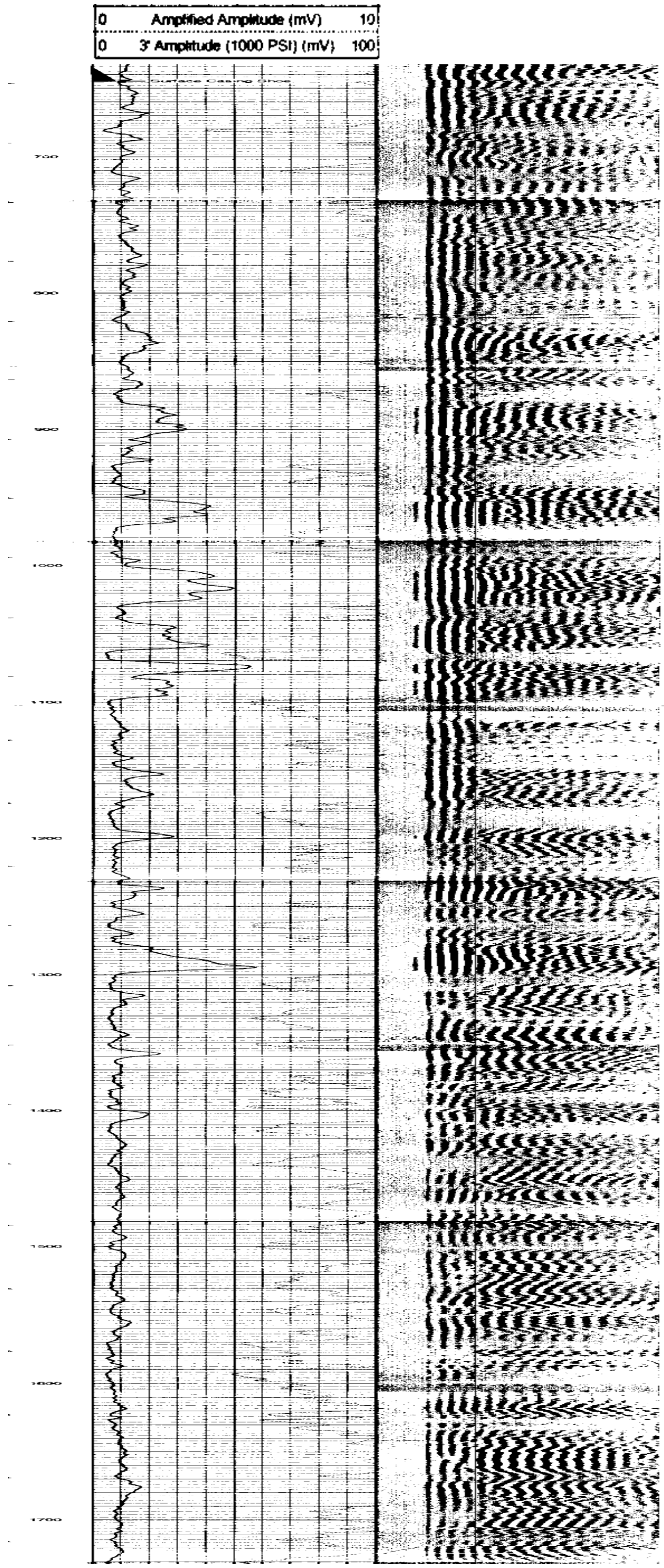

Figure E5. Example of "Good Bonding" (from surface casing at 645 ft bgs to 820 ft bgs) followed by "Sporadic Bonding" (from 820 ft bgs 1310 ft bgs) to "Good Bonding" at 1310 to target depth at Pavillion Fee 41-10B.

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