APPENDIX I
2013 PIEZOMETER INSTALLATIONS AND MONITORING REPORT

OTTER CREEK MINE

BASELINE REPORT 325A APPENDIX I

AVF PIEZOMETER INSTALLATION AND MONITORING REPORT

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1.0 INTRODUCTION

In response to a Montana Department of Environmental Quality's (DEQ) First Round Acceptability Deficiency (April 12, 2013) comment on the Otter Creek Permit Application Package, additional investigation to support the Alluvial Valley Floor study was conducted in 2013 and 2014. This report documents work conducted in response to the following comment:

- *Piezometers must be installed at appropriate rooting depths for agricultural crops grown in the lowlands adjacent to Otter Creek in order to monitor water level and water quality prior to and during mining. Please propose locations and depths for the piezometers. Placing piezometers adjacent to the existing AVF alluvial wells would seem to be appropriate, but locations upgradient and downgradient of the current AVF sections should also be considered.*

Otter Creek Coal LLC representatives, including Hydrometrics, Westech and Simpson and Associates, and DEQ staff met at the project site in July 2013 and identified and agreed upon locations for 15 shallow piezometers. These piezometers were paired with existing alluvial wells at three AVF sections. Five piezometers were also located in a reach of Otter Creek (Section 22) where no alluvial wells had previously been installed.

The purpose of the shallow piezometers is to document groundwater quality in the rooting zone, as there was concern by DEQ that alluvial water quality from monitor wells may not be representative. Water quality field measurements were collected on a monthly basis from August 2013 through July 2014 and samples for laboratory analysis were collected quarterly during the same time period. Installation and sampling methods are described in Section 2.0 and observations and results are presented in Section 3.0.

2.0 PIEZOMETER INSTALLATION AND MONITORING

Fifteen piezometers were installed during August 2013 within the AVF study area (Figure 2-1). Each piezometer installed targeted shallow groundwater in unconsolidated sediments that may coincide with the rooting zone of plants/crops growing in the Otter Creek Valley. Specifically, the perforated completion interval at each piezometer extended from within the rooting zone to a minimum of approximately two feet below the water table or a maximum of 16 feet below the ground surface. All piezometers were constructed in accordance with Montana Monitoring Well Construction Standards issued by the Montana Board of Water Well Contractors and found in ARM 36.21.801 through ARM 36.21.810. All piezometers were installed under the direction of a licensed Monitoring Well Constructor. The following procedures and materials were utilized during piezometer installation:

- Piezometers were completed in boreholes advanced to the targeted completion interval using either direct-push, hydraulically powered hollow stem auger, or hand auger methods.
- Two types of screens were utilized during piezometer completion. Screen intervals were selected on the basis of sedimentary and groundwater occurrences noted at each piezometer site. The screens utilized included the following:
    - 0.020-inch slot, 1-inch (inside diameter) U-Pack screens were used when coarser, more sandy sediments were encountered; U-pack screens consist of an outer PVC well screen and an inner centralized well screen. The annulus between the concentric screens was filled onsite with 10/20 silica sand filter media. At installation, each U-pack screen was capped at the bottom of the piezometer. Augering was used to install the boreholes for these piezometers in order to establish a large enough annulus to complete the well.
    - 0.010-inch slot ¾-inch diameter Pre-pack (factory packed with 20/30 filter sand) were used for completion when fine grained, clayey and silty sediments were encountered. A bottom cap was also placed at the bottom of the screened interval. The boreholes for these piezometers were either augered or driven with direct-push equipment.

- New 1.00-inch or 0.75-inch diameter, flush-threaded joint, schedule 40 PVC was connected to the U-pack or Pre-Pack screen and extended to approximately two feet above ground surface.
- In all piezometers, the annular seal consists of 3/8" bentonite chips installed above the sand filter packed screen up to the ground surface in accordance with Montana Board of Water Well Contractor regulations.
- Four-inch diameter protective steel casing was installed to a minimum depth of two feet below the ground surface (bgs). A steel locking lid with padlock was installed on top of the protective casing.
- Concrete surface pads were poured surrounding the protective steel casing to prevent downward percolation of surface waters.
- Piezometers were developed using either pumping, or bailing methods.
- Piezometer measuring points and ground surface elevations were surveyed using survey grade GPS equipment. The survey used a horizontal datum and vertical control consistent with that used for previous surveying of OCC features.

Soil/sediment samples were logged continuously by a geologist as each borehole was advanced. Borehole cuttings were logged to document grain-size, color, unit thickness, depth, and water occurrence. As the upper bound of the completion interval is defined by the root zone, the presence of roots, their relative quantity, and depths were recorded as part of the lithologic borehole log. A well log, containing lithology and completion information for each piezometer, has been completed and submitted to the Montana Bureau of Mines and Geology. Lithology logs and piezometer completion logs are also included in Appendix A.

As proposed, all piezometers were installed in fine-grained alluvial materials consisting primarily of layered and mixed clay, silt, and sand sediments deposited above water-bearing gravels. However, piezometer AVF8-P1 was installed in sand and gravel; piezometer AVF8-P4 was installed in fine grained sandy clay/clayey sand below shallow sand and gravel. In accordance with the work plan, the completion intervals for those piezometers were as selected because groundwater was not present in overlaying fine-grained sediments. Many of the proposed piezometers were installed at paired locations with existing AVF monitoring wells.

The initial AVF monitoring wells are completed in the deeper gravels and have bentonite seals in the shallow fine grain sediments/root zone.

Table 2-1 provides a summary of the construction details for each piezometer installed in 2013. Observations and data collected during piezometer installation and subsequent testing/monitoring included:

- Lithology
  - Type of sedimentary material and sequence, texture, color, unit thickness, depth, water (i.e., moisture) occurrence, rooting depth, and other factors useful for AVF determination.
- Groundwater Occurrence and Levels
  - Manual water levels were measured monthly during the study period.
  - Pressure transducers with continuous recorders were installed in two piezometers, AVF7-P3 and AVF4-P1.
- Water quality
  - Groundwater quality samples were collected from the piezometers for the list of parameters included in Table 2-2. Samples were collected, handled and analyzed in accordance with standard operating procedures described in Appendix A of the Otter Creek Coal Groundwater Plan of Study (October 2010).
  - Field measurement of specific conductance was conducted on a monthly basis at each piezometer.
  - Continuous specific conductance (SC) recorders were also installed in piezometers AVF7-P3 and AVF4-P1.

TABLE 2-2. ANALYTICAL PARAMETERS

PHYSICAL PARAMETERS
Specific conductance @ 25^{o} C
pH
Total Dissolved Solids
NON-METALS
Sulfate (SO4)
Chloride (Cl)
Nitrate + Nitrite as N
METALS
Calcium (Ca)
Magnesium (Mg)
Sodium (Na)
Potassium (K)

Quality control (QC) was evaluated using field QC samples (field blanks, rinsate blanks, duplicates), and laboratory control samples (matrix spikes, laboratory blanks, laboratory duplicates, and laboratory control samples). Groundwater QC consisted of one duplicate, one rinsate blank and one DI blank per 20 samples. Quality control is used to evaluate precision and accuracy of the water quality analyses. The QC results for piezometer sampling are included in the Baseline Report 304E – Hydrology, since sample collection was done concurrently with the quarterly hydrologic sampling.

3.0 OBSERVATIONS AND RESULTS

Field Observations

Four sets of piezometers were installed in the reach of Otter Creek alluvium adjacent to the proposed mine area in Tract 2. Three sets of these piezometers were paired with alluvial wells or AVF transects previously installed for baseline data collection. Key observations made during piezometer installation are discussed below. The information is presented for each piezometer transect from upstream to downstream in sequence. Piezometer locations are shown on Figure 2-1; lithologic and completion logs are included in Appendix A.

AVF4 Transect (Section 27, T4S, R45E)

- Three piezometers (AVF4-P1 through AVF4-P3) were installed adjacent to existing alluvial wells (AVF4-1, AVF4-2 and AVF4-3). Each piezometer was completed in yellowish brown silty clay at depths ranging from nine to 16 feet bgs. Depth to water during installation ranged from approximately five to 10 feet bgs.

AVF8 Transect (Section 22, T4S, R45E)

- Five piezometers (AVF8-P1 through P5) were installed in a reach of Otter Creek where no alluvial wells had previously been installed. Two of the five piezometers (AVF8-P1 and P2) are installed along the western margin of Otter Creek at the mouth of Newell Creek. Each was completed to 16 feet bgs in dry alluvial materials that included silty sand and gravels. Bedrock was encountered at 15 feet in AVF8-P1. These two wells have remained dry throughout the monitoring period with the exception of AVF8-P1 where approximately 0.40 feet of water was measured in March 2014 (Appendix B).
- AVF8-P3 and AVF8-P4 are installed on either side of Otter Creek and were completed in silts and clayey sand to about eleven feet bgs. Depth to water encountered during installation at these piezometers was approximately seven to eight feet bgs.
- AVF8-P5 was installed on the east side of Otter Creek at an elevation about 17 feet higher than the creek. This piezometer is completed in sandy clay to a depth of 14 feet. The alluvial materials in the screened interval (nine to 14 feet bgs) were very moist at the time of installation but have been dry throughout the monitoring period with the exception of March and April of 2014 where about six inches of water was measured (Appendix B).

AVF3 Transect (Section 15, T4S, R45E)

- Three piezometers (AVF3-P1 through P3) were installed adjacent to previously installed alluvial wells (AVF3-1 and AVF3-4). These piezometers were completed in yellowish brown silty sandy clay and clayey sand to depths from eight to twelve feet bgs. Water levels encountered during installation ranged from five to nine feet bgs.

AVF7 Transect (Section 9, T4S, R45E)

- Four piezometers (AVF7-P1 through P4) were installed near previously installed alluvial well A1 and clinker well C-2. These piezometers were installed in yellowish brown silts, clays and sand to depths ranging from nine to 14 feet bgs. Water was encountered during installation from five to ten feet bgs.

Groundwater Level and Quality Monitoring

Monthly measurement of depth to water and specific conductivity was completed at each piezometer from August 2013 through August 2014. These data are presented in Appendix B. When possible water levels in Otter Creek where the AVF transect crossed the creek were also surveyed at the same time groundwater levels were measured. The surface water elevations are plotted on the graphs presented in Appendix B. Groundwater levels measured during the monitoring period showed seasonal trends, with the lowest water levels observed in late summer and the highest levels associated with spring runoff/snowmelt events in March of 2014.

Field measurement of SC was conducted on a monthly basis and ranges reported for each transect are as follows with nearby monitor well SC ranges for comparison:

- AVF4: 2439 to 7280 μmhos/cm (Well AVF4-1: 2320-2800 μmhos/cm)
- AVF8: 2441 to 7120 μmhos/cm (No nearby wells)
- AVF3: 3070 – 11390 μmhos/cm (Well AVF3-2: 4110-5080 μmhos/cm)
- AVF7: 2125 to 14900 μmhos/cm (Well A1: 2320-2800 μmhos/cm)

The most notable trend of field SC observed during the monitoring period is the decrease of SC that follows the increase of water levels in early spring and the subsequent rapid increase in SC with the onset of the growing season. Water levels and SC measurements are included in graphs presented for each piezometer in Appendix B.

Water quality samples were collected from each well on a quarterly basis coincident with project wide baseline hydrologic monitoring. Laboratory analytical results of quarterly sampling are

included in Table 3-1. A summary of ranges for pH, SC, and Sodium Adsorption Ration (SAR) at each transect follow:

- AVF4:
    - pH: 7.3 - 8
    - SC: 5230 to 7010 μmhos/cm
    - SAR: 5.42 to 15.4
    - One piezometer, AVF4-P3 was dry during a portion of the monitoring period and was only sampled once due to the very small water column available during the remainder of the monitoring period. The lowest laboratory analytical values reported for pH, SC and SAR in AVF4 piezometers were reported in the one sample collected at this well in March 2014.
- AVF8:
    - pH: 7.4 – 7.8
    - SC: 2441 to 7120 μmhos/cm
    - SAR: 6.53 – 10.6
    - Three of the five piezometers were dry during the majority of the monitoring season. The above data was collected from the two piezometers closest to Otter Creek.
- AVF3:
    - pH: 7.3 – 7.6
    - SC: 5720 – 12300 μmhos/cm
    - SAR: 7.17 – 12.1
    - One (AVF3-P1) was only sampled twice during the monitoring period due to the very small water column present during the other sampling events. This sample had the lowest values reported for SC and SAR for the AVF3 wells during the monitoring period. The highest values were reported at AVF3-P2 in March 2014.
- AVF7:
    - pH: 7.3 – 7.9
    - SC: 3270 - 14100 μmhos/cm
    - SAR: 7.92 – 19.4
    - The highest concentrations of SC and SAR were both from AVF7-P4 in March 2014 while the lowest SC and SAR values were reported at AVF7-P1 in May 2014.

Summary of Results

Results of shallow piezometer investigations can be summarized from the hydrographs in Appendix B as follows:

- Shallow groundwater levels measured in piezometers were consistent with water levels measured in nearby monitor wells.
- Shallow groundwater elevations were higher than Otter Creek surface water at three of the four locations; at AVF3 the reverse was true.
- Water levels in piezometers typically varied three to four feet over the 12-month period of study, with the minimum in late summer and the peak coinciding with runoff in March.
- Specific conductivity trends varied somewhat, but typically were consistent from late summer 2013 through March, 2014, with a sharp decline in April.
- Specific conductivity rebounded sharply in May at most locations, approaching levels observed the previous summer.
- Specific conductivity ranges in piezometers were wider than in nearby wells, with lower minimums and higher (in some cases much higher) maximums.

Table 2-1
Otter Creek Mine Baseline Report 325A
Alluvial Valley Floor Study
Summary of Piezometer Construction

Piezometer	Location				Completion	Installation		Total Depth (ft.)		Water Level (ft.)		Surface	Piezometer Construction (ft.)						Description of
Number	Township	Range	Section	Qtr	Date	Method	Hole Diameter	Drilled	Plug Back	Depth	Meas. Pt.	Seal/Pad	Surf. Csg.	Riser Csg.	Seal	Sand	Screen	Slot & Diameter	Screeened Zone
AVF3-P1	4 S	45 E	15	NW	08/15/13	Direct Push	2-1/8 in.	12	--	10.95	TPVC	Concrete	+2.82 - 2.18	+1.63 - 7	+1 - 3	3 - 12	7 - 12	0.010-in. x 3/4"	Silty Sandy Clay
AVF3-P2	4 S	45 E	15	NW	08/15/13	Augered	6-1/4 in.	12	--	6.77	TPVC	Concrete	+1.89 - 3.11	+1.72 - 7	+1 - 4	4 - 12	7 - 12	0.020-in. x 1"	Clayey Sand
AVF3-P3	4 S	45 E	15	NW	08/15/13	Auger & Direct Push	6-1/4 in.	8.6 (pushed)	8 (auger T.D.)	7.29	TPVC	Concrete	+1.79 - 3.21	+1.79 - 3.6	+1 - 3	3 - 8	3.6 - 8.6	0.020-in. x 1"	Clayey Sand
AVF4-P1	4 S	45 E	27	NE	08/16/13	Direct Push	2-1/8 in.	16	--	12.75	TPVC	Concrete	+3.13 - 1.87	+2.87 - 11	+1 - 5	5 - 16	11 - 16	0.010-in. x 3/4"	Silty Clay
AVF4-P2	4 S	45 E	27	NE	08/16/13	Auger	6-1/4 in.	9	--	7.50	TPVC	Concrete	+1.94 - 3.06	+1.78 - 4	+1 - 3.5	3.5 - 9	4 - 9	0.020-in. x 1"	Silty Clay
AVF4-P3	4 S	45 E	27	NE	08/16/13	Direct Push	6-1/4 in. & 2-1/8 in.	13	--	14.80	TPVC	Concrete	+2.76 - 2.27	+2.70 - 8	+1 - 5	5 - 13	8 - 13	0.010-in. x 3/4"	Silty Clay
AVF7-P1	4 S	45 E	9	NE	08/14/13	Direct Push	6-1/4 in.	14	9 (Slough)	12.22	TPVC	Concrete	+2.09 - 2.91	+2.09 - 9	+2 - 7	7 - 14	9 - 14	0.020-in. x 1"	Sand w/ Silt and Clay
AVF7-P2	4 S	45 E	9	NE	08/14/13	Direct Push	2-1/8 in.	16	14 (Slough)	13.68	TPVC	Concrete	+3.08 - 1.92	+2.71 - 9	+1 - 6	6 - 14	9 - 14	0.010-in. x 3/4"	Silt, Sand and Clay
AVF7-P3	4 S	45 E	9	NE	08/14/13	Auger	6-1/4 in.	11	--	5.91	TPVC	Concrete	+1.78 - 3.22	+1.45 - 6	+1 - 3.5	3.5 - 11	6 - 11	0.020-in. x 1"	Sand
AVF7-P4	4 S	45 E	9	NE	08/15/13	Auger	6-1/4 in.	9	--	6.94	TPVC	Concrete	+2.39 -2.25	+2.39 - 4	+1 - 3.5	3.5 - 9	4 - 9	0.020-in. x 1"	Sandy Clay
AVF8-P1	4 S	45 E	22	NW	08/15/13	Direct Push	2-1/2 in.	16	--	Dry	TPVC	Concrete	+2.28 - 2.72	+1.59 - 11	+1 - 8.5	8.5 - 16	11 - 16	0.010-in. x 3/4"	Gravel
AVF8-P2	4 S	45 E	22	NW	08/15/13	Direct Push	6-1/4 in. & 2-1/8 in.	16	--	Dry	TPVC	Concrete	+2.97 - 2.03	+2.54 - 11	+1 - 6	6 - 16	11 - 16	0.010-in. x 3/4"	Sandy Clay
AVF8-P3	4 S	45 E	22	NE	08/15/13	Auger	6-1/4 in.	11	--	8.61	TPVC	Concrete	+1.90 - 3.10	+1.58 - 6	+1 - 4	4 - 11	6 - 11	0.020-in. x 1"	Clayey Sand
AVF8-P4	4 S	45 E	22	NE	08/16/13	Auger & Direct Push	6-1/4 in.	12 (pushed)	11 (auger T.D.)	9.40	TPVC	Concrete	+1.88 - 3.22	+1.60 - 7	+1 - 5	5 - 11	7 - 12	0.020-in. x 1"	Sandy Clay
AVF8-P5	4 S	45 E	22	NE	08/16/13	Auger & Direct Push	6-1/4 in. & 2-1/8 in.	16 (pushed)	14 (auger cuttings)	Dry	TPVC	Concrete	+2.36 - 2.64	+2.24 - 9	+1 - 3	9 - 14	9 - 14	0.010-in. x 3/4"	Clayey Sand

Notes & Comments:

Meas. Pt. = Measuring Point (TPVC = Top of PVC casing)

TABLE 3-1
BASELINE REPORT 325A APPENDIX I
LABORATORY ANALYTICA RESULTS - GROUNDWATER

		sys_loc_code	AVF3-P1	AVF3-P1	AVF3-P2	AVF3-P2	AVF3-P2	AVF3-P2	AVF3-P3	AVF3-P3	AVF3-P3	AVF3-P3
		sample_date	11/21/2013	4/15/2014	8/28/2013	11/21/2013	4/15/2014	5/12/2014	8/28/2013	11/21/2013	4/15/2014	5/12/2014
		sys_sample_code	OCC-1311-103	OCC-1404-102	OCC-1308-905	OCC-1311-153	OCC-1404-104	OCC-1405-207	OCC-1308-904	OCC-1311-102	OCC-1404-105	OCC-1405-208
		lab_sample_id	H13110493-010	H14040323-001	H13080563-005	H13110493-014	H14040323-003	H14050292-008	H13080563-004	H13110493-002	H14040323-004	H14050292-009
chemical_name	result_unit	fraction	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text
CALCIUM (CA)	mg/L	DIS	333	275	338	319	408	402	212	192	304	286
CHLORIDE (CL)	mg/L	NO MEAS	77	62	77	74	94	64	47	47	77	49
MAGNESIUM (MG)	mg/L	DIS	273	236	691	669	1020	991	312	298	482	451
NITRATE + NITRITE AS N	mg/L	NO MEAS	0.05	0.1	< 0.01	< 0.01	0.02	< 0.01	< 0.01	0.01	< 0.01	< 0.01
pH - LAB	s.u.	NO MEAS	7.6	7.4	7.3	7.3	7.4	7.3	7.4	7.4	7.5	7.5
POTASSIUM (K)	mg/L	DIS	22	13	27	25	25	24	20	18	21	20
SC (UMHOS/CM AT 25 C)	umhos/cm	NO MEAS	5720	5340	9920	9660	12300	12200	6030	5930	7540	7230
SODIUM (NA)	mg/L	DIS	725	708	1410	1330	2000	1930	874	822	1150	1180
SODIUM ADSORPTION RATIO	unitless	NO MEAS	7.14	7.57	10.1	9.74	12.1	11.7	8.92	8.66	9.54	10.1
SULFATE (SO4)	mg/L	NO MEAS	2800	2600	6000	5500	8900	7500	2800	2800	4400	3600
TDS (MEASURED AT 180 C)	mg/L	NO MEAS	4940	4780	7920	9020	13500	13100	4090	4740	7010	6730

TABLE 3-1
BASELINE REPORT 325A APPENDIX I
LABORATORY ANALYTICA RESULTS - GROUNDWATER

		sys_loc_code	AVF4-P1	AVF4-P1	AVF4-P1	AVF4-P1	AVF4-P2	AVF4-P2	AVF4-P2	AVF4-P2	AVF4-P3	AVF7-P1
		sample_date	8/28/2013	11/21/2013	3/20/2014	5/14/2014	8/28/2013	11/21/2013	3/19/2014	5/14/2014	3/19/2014	8/28/2013
		sys_sample_code	OCC-1308-909	OCC-1311-106	OCC-1403-415	OCC-1405-216	OCC-1308-910	OCC-1311-157	OCC-1403-412	OCC-1405-217	OCC-1403-411	OCC-1308-902
		lab_sample_id	H13080563-009	H13110493-005	H14030299-016	H14050292-017	H13080563-010	H13110493-018	H14030299-013	H14050292-018	H14030299-012	H13080563-003
chemical_name	result_unit	fraction	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text
CALCIUM (CA)	mg/L	DIS	42	42	38	46	213	220	188	201	269	104
CHLORIDE (CL)	mg/L	NO MEAS	41	42	46	33	32	32	26	15	8	40
MAGNESIUM (MG)	mg/L	DIS	223	233	218	261	433	443	406	422	355	226
NITRATE + NITRITE AS N	mg/L	NO MEAS	1.99	2.38	3.24	3	< 0.01	< 0.01	< 0.01	< 0.01	1.25	0.68
pH - LAB	s.u.	NO MEAS	8	8	8	8	7.4	7.4	7.4	7.4	7.3	7.5
POTASSIUM (K)	mg/L	DIS	25	25	24	25	28	26	23	23	11	30
SC (UMHOS/CM AT 25 C)	umhos/cm	NO MEAS	6260	6310	6020	6070	6980	7010	6410	6250	5230	4550
SODIUM (NA)	mg/L	DIS	1090	1150	1110	1190	965	1010	947	973	576	710
SODIUM ADSORPTION RATIO	unitless	NO MEAS	14.82	15.4	15.3	15	8.72	9.02	8.9	8.95	5.42	8.95
SULFATE (SO4)	mg/L	NO MEAS	2800	2800	2900	2800	3700	3700	3700	3500	2800	1900
TDS (MEASURED AT 180 C)	mg/L	NO MEAS	4120	4640	4840	4860	5100	5920	5870	5730	4810	3120

TABLE 3-1
BASELINE REPORT 325A APPENDIX I
LABORATORY ANALYTICA RESULTS - GROUNDWATER

		sys_loc_code	AVF7-P1	AVF7-P1	AVF7-P1	AVF7-P2	AVF7-P2	AVF7-P2	AVF7-P3	AVF7-P3	AVF7-P3	AVF7-P3
		sample_date	11/21/2013	3/24/2014	5/12/2014	11/22/2013	3/20/2014	5/12/2014	8/28/2013	11/21/2013	3/25/2014	5/12/2014
		sys_sample_code	OCC-1311-152	OCC-1403-425	OCC-1405-204	OCC-1311-101	OCC-1403-416	OCC-1405-206	OCC-1308-901	OCC-1311-100	OCC-1403-426	OCC-1405-203
		lab_sample_id	H13110493-013	H14030353-011	H14050292-005	H13110493-009	H14030299-017	H14050292-007	H13080563-002	H13110493-001	H14030353-012	H14050292-004
chemical_name	result_unit	fraction	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text
CALCIUM (CA)	mg/L	DIS	104	90	74	70	50	53	191	182	149	146
CHLORIDE (CL)	mg/L	NO MEAS	40	32	16	29	28	19	43	37	26	19
MAGNESIUM (MG)	mg/L	DIS	222	178	150	134	115	122	495	461	430	410
NITRATE + NITRITE AS N	mg/L	NO MEAS	0.3	0.95	0.6	0.65	0.59	1.06	< 0.01	0.02	0.03	0.02
pH - LAB	s.u.	NO MEAS	7.6	7.6	7.6	7.8	7.9	7.8	7.7	7.5	7.5	7.5
POTASSIUM (K)	mg/L	DIS	29	25	23	25	25	24	33	30	25	24
SC (UMHOS/CM AT 25 C)	umhos/cm	NO MEAS	4720	4050	3270	4130	3890	3590	8580	8420	7400	8020
SODIUM (NA)	mg/L	DIS	732	632	517	698	694	675	1340	1380	1340	1390
SODIUM ADSORPTION RATIO	unitless	NO MEAS	9.29	8.88	7.92	11.3	12.4	11.6	11.62	12.4	12.6	13.3
SULFATE (SO4)	mg/L	NO MEAS	1900	1600	1200	1500	1500	1300	4700	4700	3900	4200
TDS (MEASURED AT 180 C)	mg/L	NO MEAS	3520	3100	2340	2900	2820	2670	6250	7150	6780	6880

TABLE 3-1
BASELINE REPORT 325A APPENDIX I
LABORATORY ANALYTICA RESULTS - GROUNDWATER

		sys_loc_code	AVF7-P4	AVF7-P4	AVF7-P4	AVF7-P4	AVF8-P3	AVF8-P3	AVF8-P3	AVF8-P3	AVF8-P4	AVF8-P4
		sample_date	8/28/2013	11/21/2013	3/24/2014	5/12/2014	8/28/2013	11/21/2013	3/31/2014	5/13/2014	8/28/2013	11/21/2013
		sys_sample_code	OCC-1308-900	OCC-1311-151	OCC-1403-423	OCC-1405-201	OCC-1308-907	OCC-1311-155	OCC-1403-941	OCC-1405-215	OCC-1308-906	OCC-1311-104
		lab_sample_id	H13080563-001	H13110493-012	H14030353-009	H14050292-002	H13080563-007	H13110493-016	H14040086-002	H14050292-016	H13080563-006	H13110493-003
chemical_name	result_unit	fraction	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text	report_result_text
CALCIUM (CA)	mg/L	DIS	273	270	271	325	191	191	180	151	184	192
CHLORIDE (CL)	mg/L	NO MEAS	41	33	34	25	28	26	23	13	32	30
MAGNESIUM (MG)	mg/L	DIS	666	701	835	950	338	340	332	285	347	364
NITRATE + NITRITE AS N	mg/L	NO MEAS	< 0.01	0.12	1.26	0.05	< 0.01	< 0.01	0.08	< 0.01	0.05	0.17
pH - LAB	s.u.	NO MEAS	7.3	7.3	7.4	7.3	7.5	7.4	7.4	7.4	7.8	7.7
POTASSIUM (K)	mg/L	DIS	29	26	27	28	25	24	23	21	35	31
SC (UMHOS/CM AT 25 C)	umhos/cm	NO MEAS	10900	11000	14100	14000	5680	5540	5220	4340	6750	6690
SODIUM (NA)	mg/L	DIS	1790	1940	2860	2750	730	780	743	591	986	972
SODIUM ADSORPTION RATIO	unitless	NO MEAS	13.29	14.1	19.4	17.4	7.35	7.84	7.59	6.53	9.87	9.5
SULFATE (SO4)	mg/L	NO MEAS	6400	6900	9200	8400	2800	2900	2800	2100	3500	3400
TDS (MEASURED AT 180 C)	mg/L	NO MEAS	8710	10100	15100	13900	4220	4580	4580	3590	4660	5470

TABLE 3-1
BASELINE REPORT 325A APPENDIX I
LABORATORY ANALYTICA RESULTS - GROUNDWATER

		sys_loc_code	AVF8-P4	AVF8-P4					
		sample_date	3/31/2014	5/13/2014					
		sys_sample_code	OCC-1403-940	OCC-1405-214					
		lab_sample_id	H14040086-001	H14050292-015					
chemical_name	result_unit	fraction	report_result_text	report_result_text	min	max	mean	count	detects
CALCIUM (CA)	mg/L	DIS	189	156	38	408	193	42	42
CHLORIDE (CL)	mg/L	NO MEAS	26	19	8	94	38	42	42
MAGNESIUM (MG)	mg/L	DIS	384	376	115	1020	411	42	42
NITRATE + NITRITE AS N	mg/L	NO MEAS	0.37	0.3	0.01	3.24	0.46	42	27
pH - LAB	s.u.	NO MEAS	7.6	7.7	7.3	8	8	42	42
POTASSIUM (K)	mg/L	DIS	31	33	11	35	25	42	42
SC (UMHOS/CM AT 25 C)	umhos/cm	NO MEAS	6460	6370	3270	14100	7050	42	42
SODIUM (NA)	mg/L	DIS	1080	1080	517	2860	1132	42	42
SODIUM ADSORPTION RATIO	unitless	NO MEAS	10.4	10.6	5.42	19.4	10.74	42	42
SULFATE (SO4)	mg/L	NO MEAS	3400	3400	1200	9200	3790	42	42
TDS (MEASURED AT 180 C)	mg/L	NO MEAS	5750	5500	2340	15100	6081	42	42

UPDATE TIME: 2:25 PM
JBERGIN\BIL\20141006\i:\LAND PROJECTS\OTRCR\DWG\325A\FIGURE2-1_AVF_PIEZOMETER_LOCATIONS_R1_2014.DWG

SW-25
A8
AVF-6-PH1
AVF-6-4
AVF-6-3
AVF-6-5
SW-3
AVF-6-1
AVF-6-2
SW-4
SW-5
TRACT 1
TRACT 2
P3
SW-7
SW-6
AVF-7-P2
AVF-7-P3
AVF-7-P4
AVF-7-P1
C-2
A1
SW-2
MET STATION
B5-O
B5-K
B5-U
B5-PH1
C-3
SW-13
P1
B9-U
B9-K
AVF-3-3
AVF-3-1
AVF-3-2
AVF-3-4
AVF-3-P3
AVF-3-P1
AVF-3-P2
SW-14
C-4
SW-15
K-5
TRACT 3
B11-O
B11-K
B11-U
SW-16
A6
K-1
P2
SW-17
AVF-8-P5
AVF-8-P2
AVF-8-P4
AVF-8-P1
AVF-8-P3
AVF-4-P2
AVF-4-P3
SW-18
AVF-4-P1
AVF-4-3
AVF-4-1
AVF-4-4
AVF-4-2
K-2 (LOWER KNOBLOCH)
K-6 (UPPER KNOBLOCH)
A7
SW-19
K3 (UPPER KNOBLOCH)

NORTH

SCALE
(In Feet)
0 1500

Legend:

- Contour Major (25 feet)
- Contour Minor (5 feet)
- Drainages
- Paved Road
- Mining Area
- Mine Permit Boundary
- Tract Boundary
- Township Lines
- Section Lines
- Suface Water Monitoring Station (SW-21)
- Piezometer (AVF-8-P5)
- Pond Monitoring Location (P3)
- Monitoring Well Location (K-3)

Hydrometrics, Inc.
Consulting Scientists and Engineers

Otter Creek Mine Permit ID: C2012018
Environmental Baseline Report 325A
Alluvial Valley Floor Identification

AVF PIEZOMETER LOCATIONS

FIGURE
2-1

APPENDIX A

PIEZOMETER LITHOLOGIC AND COMPLETION LOGS

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF3-P1

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

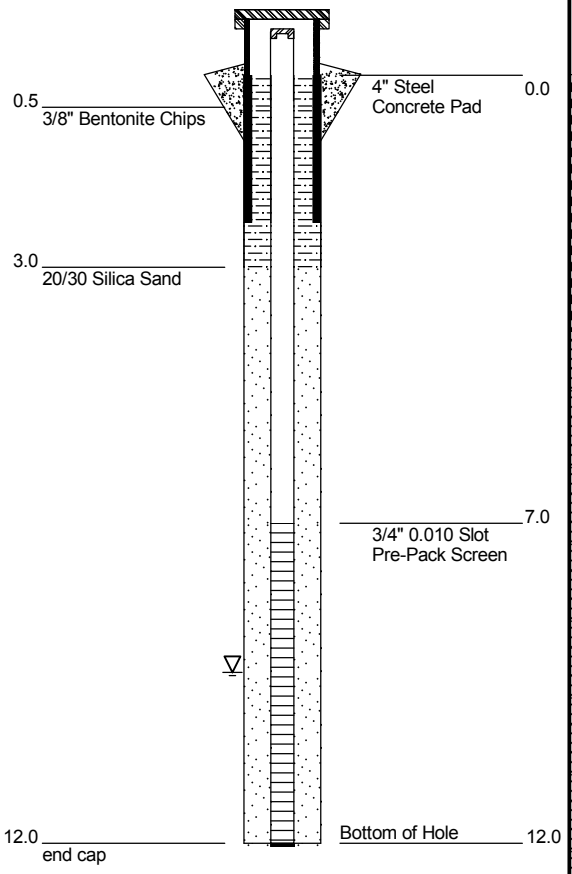
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 15, NW1/4; N 470024.461, E 2823417.91
Location Description:
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 2 1/8"
Total Depth Drilled (ft): 12

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4", flush threaded, Sch 40, PVC	+2.82-12
Surface Casing Used?	Y	4" steel	+2.82-2.18
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	7-12
Sand Pack?	Y	20/30 Silica Sand	3-12
Annular Seal?	Y	3/8" Bentonite Chips	+1-3
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 470024.461 Easting: 2823417.908
Static Water Level Below MP: 10.95 Surface Casing Height (ft): 2.82
Date: 8/28/2013 Riser Height (ft): 1.62
MP Description: Top PVC Ground Surface Elevation (ft): 3050.069
MP Height Above or Below Ground (ft): 1.62 MP Elevation (ft): 3051.69

Remarks: Direct Pushed pilot hole to 14'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 5' and direct pushed to 12'. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 sand pack is 3'-12'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Clay**
dry; pale yellowish brown; moderatly loose; trace sand; roots

4.0 - 13.0' **Silty Sandy Clay**
dry to very moist; moderate yellowish brown; loose; very sandy from 12'-13'

13.0 - 14.0' **Sandy Gravel**
wet; light brown to moderate yellowish brown; clinker gravel up to 3/4" in size

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF3-P2

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

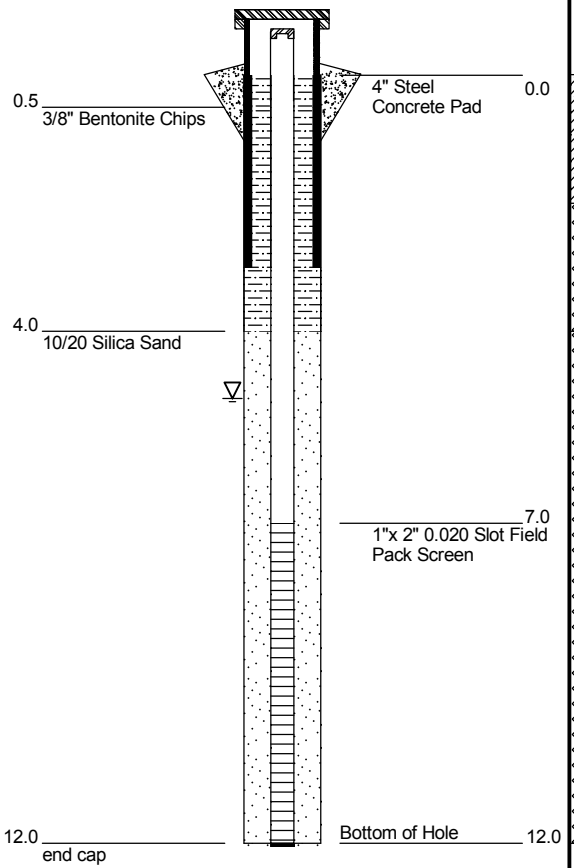
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 15, NW1/4; N 470133.416, E 2823054.21
Location Description:
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 12

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+1.89-12
Surface Casing Used?	Y	4" steel	+1.89-3.11
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	7-12
Sand Pack?	Y	10/20 Silica Sand	4-12
Annular Seal?	Y	3/8" Bentonite Chips	+1-4
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 470133.416 Easting: 2823054.211
Static Water Level Below MP: 6.77 Surface Casing Height (ft): 1.89
Date: 8/28/2013 Riser Height (ft): 1.72
MP Description: Top PVC Ground Surface Elevation (ft): 3045.329
MP Height Above or Below Ground (ft): 1.72 MP Elevation (ft): 3047.04

Remarks: Direct Pushed pilot hole to 12'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 3' and augered to 12'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 2.0' **Sandy Clay**
dry to moist; light yellowish brown; loose roots

2.0 - 4.0' **Clayey Sand**
very moist to wet; moderate yellowish brown; very loose

4.0 - 12.0' **Clayey Sand**
wet; moderate yellowish brown; very loose

STANDARD_REV3 OTTER CREEK WELL LOGS.GPJ HYDHLN2.GDT 10/6/14

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF3-P3

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 15, NW1/4; N 470379.922, E2822669.47
Location Description:

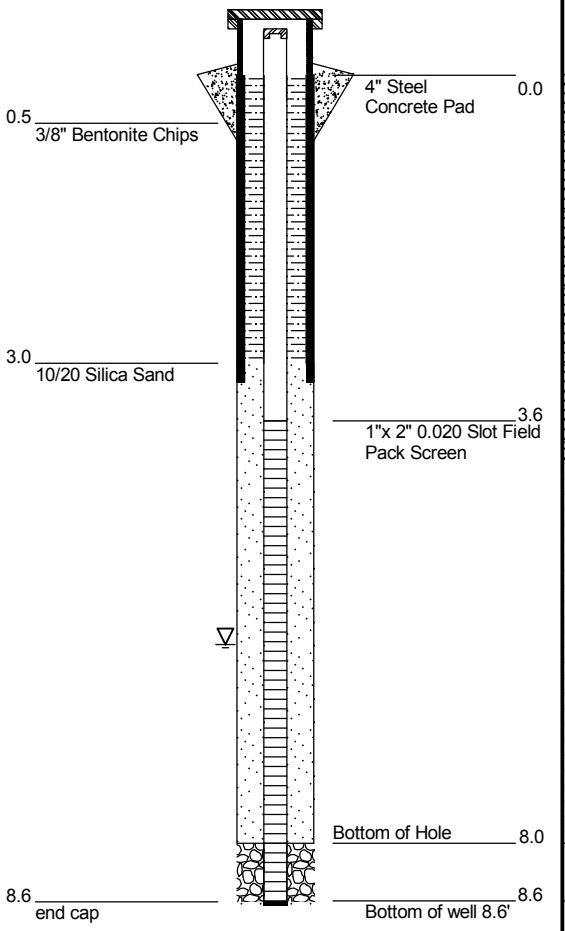
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 8

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+1.79-8.6
Surface Casing Used?	Y	4" steel	+1.79-3.21
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	3.6-8.6
Sand Pack?	Y	10/20 Silica Sand	3-8
Annular Seal?	Y	3/8" Bentonite Chips	+1-3
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 470379.922 Easting: 2822669.476
Static Water Level Below MP: 7.29 Surface Casing Height (ft): 1.79
Date: 8/28/2013 Riser Height (ft): 1.36
MP Description: Top PVC Ground Surface Elevation (ft): 3043.64
MP Height Above or Below Ground (ft): 1.36 MP Elevation (ft): 3044.99

Remarks: Direct Pushed pilot hole to 8'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 3' and augered to 8'. Well pushed in and completed at 8.6' below ground surface due to soft clay.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Sandy Clayey Silt**
dry to moist; pale to moderate yellowish brown

4.0 - 8.0' **Clayey Sand**
wet; moderate yellowish brown; tagged gravel at 8'; 1/4" coal and clinker gravel

8.0 - 8.6' **No Core Logged**
well advanced passed the drilled depth

Hydrometrics, Inc.

Consulting Scientists and Engineers

Billings, Montana

Monitor Well Log

Hole Name: AVF4-P1

Date Hole Started: 8/16/13 Date Hole Finished: 8/16/13

Client: Arch Coal

Project: Otter Creek Mine Permit (10068)

County: Powder River State: Montana

Property Owner: Great Northern Properties

Legal Description: T4S, R45E, Sec. 27, NE1/4; N 461128.44, E 2824540.89
Location Description: Near AVF4-3

Recorded By: RJL

Drilling Company: Hydrometrics, Inc

Driller: Larry Johnson and Carl Lanz

Drilling Method: Direct Push

Drilling Fluids Used: None

Purpose of Hole: Install Monitor Well

Target Aquifer: Root Zone Ground Water

Hole Diameter (in): 2 1/8"

Total Depth Drilled (ft): 16

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4"-inch, flush threaded, Sch 40, PVC	+3.13-16
Surface Casing Used?	Y	4" steel	+3.13-1.87
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	11-16
Sand Pack?	Y	20/30 Silica Sand	5-16
Annular Seal?	Y	3/8 Bentonite Chips	+1-5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 461128.447 Easting: 2824540.897

Static Water Level Below MP: 12.75 Surface Casing Height (ft): 3.13

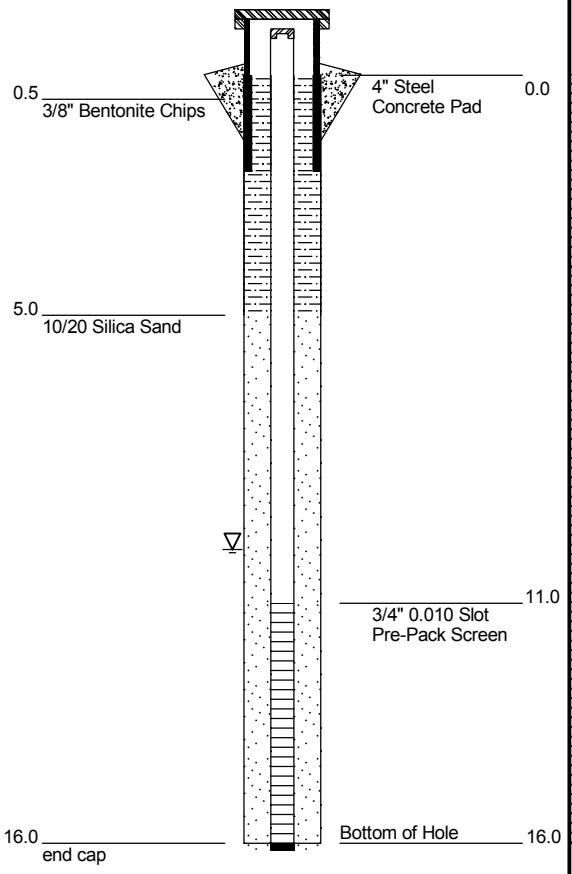
Date: 8/28/2013 Riser Height (ft): 2.87

MP Description: Top PVC Ground Surface Elevation (ft): 3074.143

MP Height Above or Below Ground (ft): 2.87 MP Elevation (ft): 3077.01

Remarks: Direct Pushed to 16'. Installed 3/4" well to 16'. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 sand pack is 5'-16'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silty Clay**
dry; moderate yellowish brown to pale yellowish brown; roots

4.0 - 16.0' **Silty Clay**
moist to wet, moderate yellowish brown; trace sand (minor)

STANDARD_REV3 OTTER CREEK WELL LOGS.GPJ HYDHLN2.GDT 10/6/14

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF4-P2

Date Hole Started: 8/16/13 Date Hole Finished: 8/16/13

Client: Arch Coal

Project: Otter Creek Mine Permit (10068)

County: Powder River State: Montana

Property Owner: Great Northern Properties

Legal Description: T4S, R45E, Sec. 27, NE1/4; N 461288.85, E 2825354.32
Location Description: Near AVF4-1

Recorded By: RJL

Drilling Company: Hydrometrics, Inc

Driller: Larry Johnson and Carl Lanz

Drilling Method: Auger/ Direct Push

Drilling Fluids Used: None

Purpose of Hole: Install Monitor Well

Target Aquifer: Root Zone Ground Water

Hole Diameter (in): 6 1/4"

Total Depth Drilled (ft): 9

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+1.94-9
Surface Casing Used?	Y	4" steel	+1.94-3.06
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	4-9
Sand Pack?	Y	10/20 Silica Sand	3.5-9
Annular Seal?	Y	3/8 Bentonite Chips	+1-3.5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 461288.857 Easting: 2825354.322

Static Water Level Below MP: 7.50 Surface Casing Height (ft): 1.94

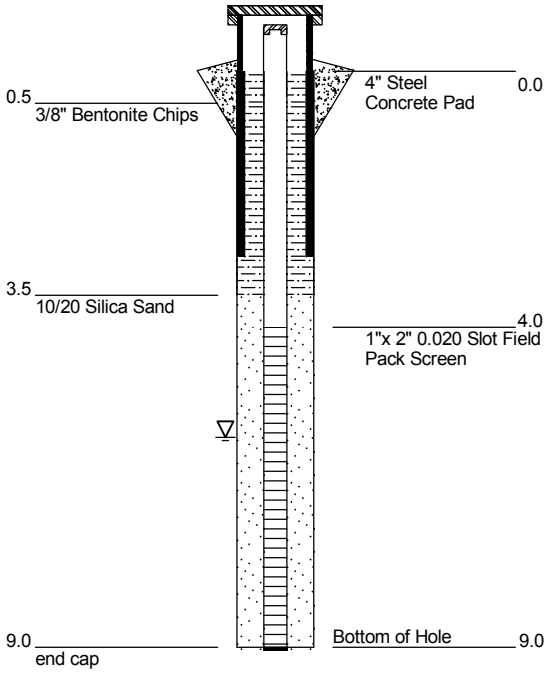
Date: 8/28/2013 Riser Height (ft): 1.78

MP Description: Top PVC Ground Surface Elevation (ft): 3069.489

MP Height Above or Below Ground (ft): 1.78 MP Elevation (ft): 3071.27

Remarks: Direct Pushed pilot hole to 12'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 5' and augered to 9'. Completed well at 9'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 12.0' **Silty Clay**
dry to wet; moderate yellowish brown; some sand; loose; roots in upper interval; tagged sand and gravel at 12'; poorly sorted fine gravels to coarse sands

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF4-P3

Date Hole Started: 8/16/13 Date Hole Finished: 8/16/13

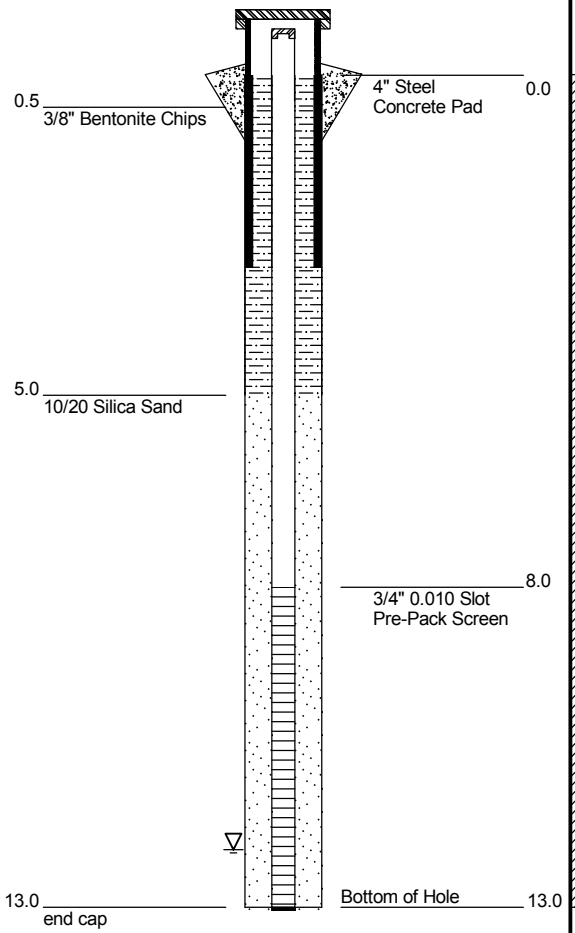
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 27, NE1/4; N 461404.08, E 2826287.52
Location Description: East end of AVF4 near mouth of Fortune Creek
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4" (0'-3'); 2 1/8" (3'- 13')
Total Depth Drilled (ft): 13

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4"-inch, flush threaded, Sch 40, PVC	+2.73-13
Surface Casing Used?	Y	4" steel	+2.73-2.27
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	8-13
Sand Pack?	Y	20/30 Silica Sand	5-13
Annular Seal?	Y	3/8 Bentonite Chips	+1-5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 461404.088 Easting: 2826287.521
Static Water Level Below MP: 14.80 Surface Casing Height (ft): 2.73
Date: 8/28/2013 Riser Height (ft): 2.70
MP Description: Top PVC Ground Surface Elevation (ft): 3075.858
MP Height Above or Below Ground (ft): 2.70 MP Elevation (ft): 3078.56

Remarks: Direct Pushed to 13'. Installed 3/4" well to 13'. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 sand pack is 5'-13'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 13.0' **Silty Clay**
dry to wet; moderate yellowish brown

STANDARD_REV3 OTTER CREEK WELL LOGS.GPJ HYDHLN2.GDT 10/6/14

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF7-P1

Date Hole Started: 8/14/13 Date Hole Finished: 8/14/13

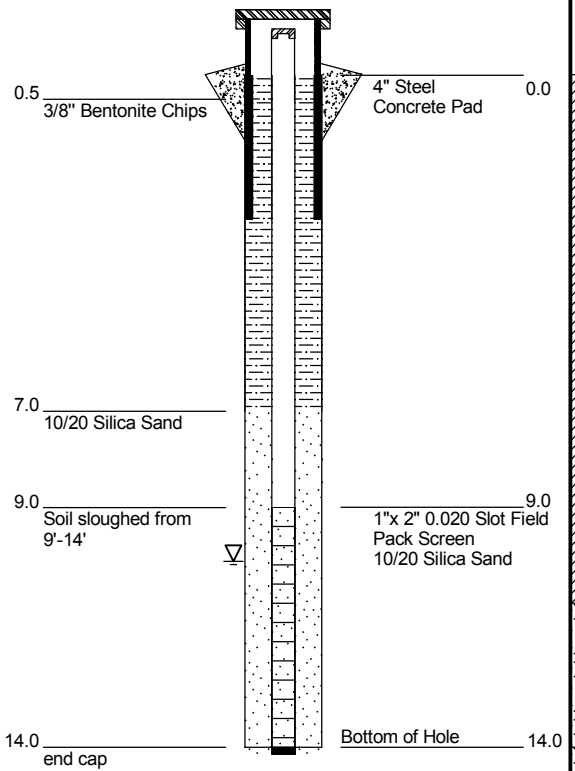
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Ark Land Company
Legal Description: T4S, R45E, Sec. 9, NE1/4; N 476126.85, E 2819323.30
Location Description:
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 14

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+2.09-14
Surface Casing Used?	Y	4" steel	+2.34-2.66
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	9-14
Sand Pack?	Y	10/20 Silica Sand	7-14
Annular Seal?	Y	3/8 Bentonite Chips	+2-7
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 476126.859 Easting: 2819323.308
Static Water Level Below MP: 12.22 Surface Casing Height (ft): 2.34
Date: 8/28/2013 Riser Height (ft): 2.09
MP Description: Top PVC Ground Surface Elevation (ft): 3035.06
MP Height Above or Below Ground (ft): 2.09 MP Elevation (ft): 3037.15

Remarks: Wet at 11' bgs. Direct Push to 19' no gravel. Tripped out and moved rig ~2'. 2 1/4" Direct Push hole collapsed to 9' when tools were pulled. Piezometer was pushed to 14' through sloughed soils.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 11.0' **Silty Clay**
dry to moist at 7'; moderate yellowish brown; non plastic to moderately plastic w/ depth trace sand at 9'

11.0 - 14.0' **Sand with Silt and Clay**
wet; moderate yellowish brown; loose

14.0 - 18.0' **Sand**
as above, less fines with depth

18.0 - 19.0' **Sand and Gravel**
loose; moderate yellowish brown to light brown; gravel is clinker in orgin and up to 1/4" in size.

STANDARD_REV3 OTTER CREEK WELL LOGS.GPJ HYDHLN2.GDT 10/6/14

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF7-P2

Date Hole Started: 8/14/13 Date Hole Finished: 8/14/13

Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Ark Land Company
Legal Description: T4S, R45E, Sec. 9, NE1/4; N 476095.23, E 2818915.08
Location Description:

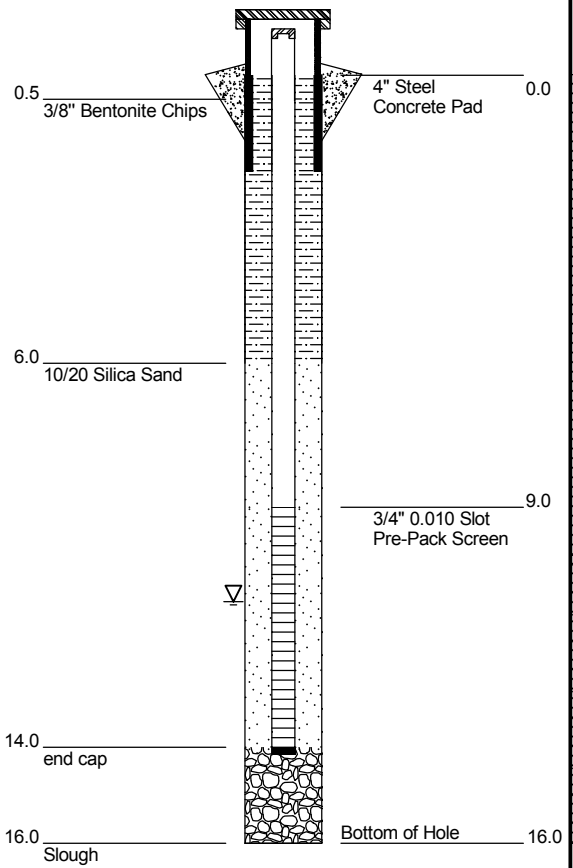
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 2 1/8"
Total Depth Drilled (ft): 16

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4"-inch, flush threaded, Sch 40, PVC	+3.08-14
Surface Casing Used?	Y	4" steel	+3.08-1.92
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	9-14
Sand Pack?	Y	20/30 Silica Sand	6-14
Annular Seal?	Y	3/8 Bentonite Chips	+1-6
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 476095.232 Easting: 2818915.087
Static Water Level Below MP: 13.68 Surface Casing Height (ft): 3.08
Date: 8/28/2013 Riser Height (ft): 2.71
MP Description: Top PVC Ground Surface Elevation (ft): 3035.33
MP Height Above or Below Ground (ft): 2.71 MP Elevation (ft): 3038.04

Remarks: Direct Push to 16'. Hole sloughed to 14', set 3/4" well to 14'. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 sand pack is 6'-14'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 10.0' **Silty Clay**
dry to moist with depth; moderate yellowish brown to moderate brown; roots to 5'; some sand at depth

10.0 - 16.0' **Silt, Sand, and Clay**
moist to wet; moderate yellowish brown; loose; some coarse sand from 12'-16'

STANDARD_REV3 OTTER CREEK WELL LOGS.GPJ HYDHLN2.GDT 10/6/14

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF7-P3

Date Hole Started: 8/14/13 Date Hole Finished: 8/14/13

Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Ark Land Company
Legal Description: T4S, R45E, Sec. 9, NE1/4; N 476190.12, E 2819849.76
Location Description:

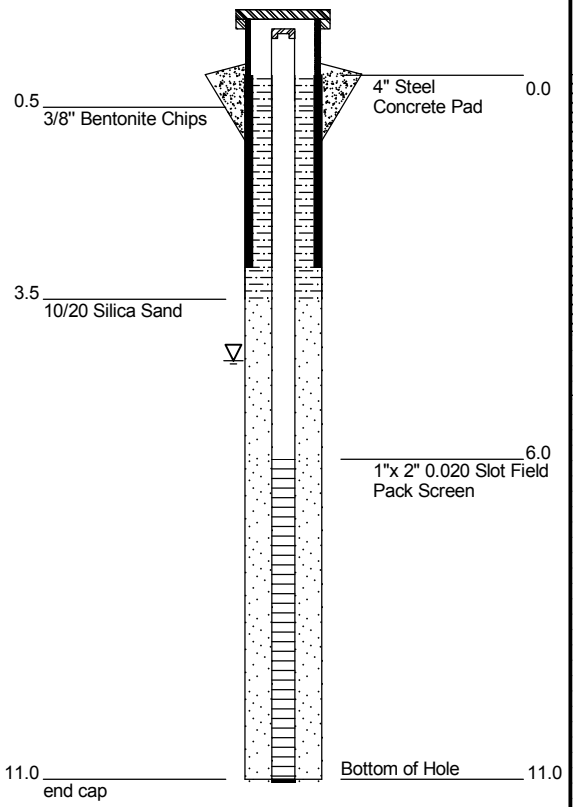
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 11

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+1.45-11
Surface Casing Used?	Y	4" steel	+1.78-3.22
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	6-11
Sand Pack?	Y	10/20 Silica Sand	3.5-11
Annular Seal?	Y	3/8 Bentonite Chips	+1-3.5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 476190.121 Easting: 2819849.76
Static Water Level Below MP: 5.91 Surface Casing Height (ft): 1.78
Date: 8/28/2013 Riser Height (ft): 1.45
MP Description: Top PVC Ground Surface Elevation (ft): 3029.089
MP Height Above or Below Ground (ft): 1.45 MP Elevation (ft): 3030.54

Remarks: Direct Pushed pilot hole to 12'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 3' and augered to 11'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silty Clay**
dry to moist with depth; very fine sand with depth; loose soft (roots)

4.0 - 5.0' **Silty Sand**
slighty moist; moderate yellowish brown

5.0 - 12.0' **Sand**
wet; moderate yellowish brown; loose to very loose; poorly sorted very fine to medium sand, some silt and clay to lots of fines at depth

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF7-P4

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Ark Land Company
Legal Description: T4S, R45E, Sec. 9, NE1/4; N 476220.01, E 2820263.05
Location Description:

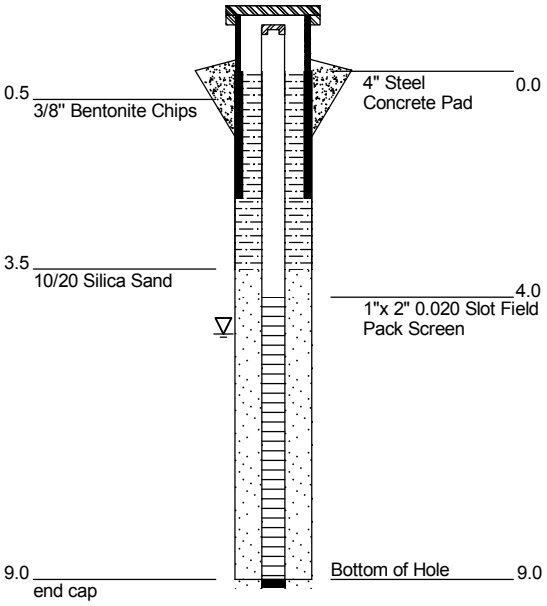
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 9

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+2.29-9
Surface Casing Used?	Y	4" steel	+2.39-2.25
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	4-9
Sand Pack?	Y	10/20 Silica Sand	3.5-9
Annular Seal?	Y	3/8 Bentonite Chips	+1-3.5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 476220.018 Easting: 2820263.055
Static Water Level Below MP: 6.94 Surface Casing Height (ft): 2.39
Date: 8/28/2013 Riser Height (ft): 2.29
MP Description: Top PVC Ground Surface Elevation (ft): 3029.119
MP Height Above or Below Ground (ft): 2.29 MP Elevation (ft): 3031.41

Remarks: Direct Pushed pilot hole to 16'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 3' and augered to 9'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silt**
dry; pale yellowish brown; trace clay and fine sand; loose, roots

4.0 - 8.0' **Sandy Clay**
to clayey sand; dry to very moist at 5'; moderate yellowish brown; very soft;

8.0 - 12.0' **Sandy Clay**
as above; wet

12.0 - 16.0' **Sandy Gravel**
wet; moderate yellowish brown sand to light brown clinker gravel; sub-angular up to 3/4"

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF8-P1

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

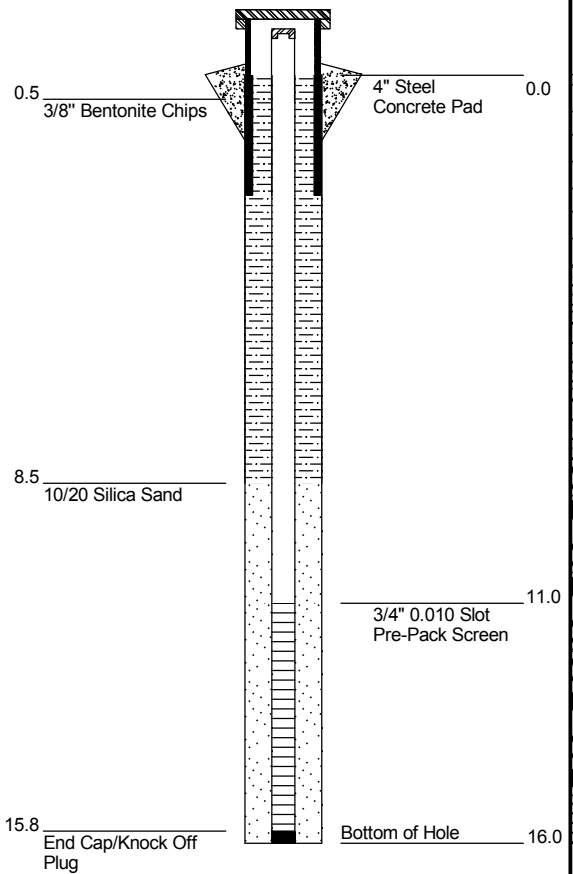
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 22, NW1/4; N 464455.85, E 2823411.65
Location Description:
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 2 1/2"
Total Depth Drilled (ft): 16

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4"-inch, flush threaded, Sch 40, PVC	+1.59-16
Surface Casing Used?	Y	4" steel	+2.28-2.72
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	11-16
Sand Pack?	Y	20/30 Silica Sand	8.5-16
Annular Seal?	Y	3/8 Bentonite Chips	+1-8.5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 464455.857 Easting: 2823411.658
Static Water Level Below MP: Dry at 17.38' Surface Casing Height (ft): 2.28
Date: 8/28/2013 Riser Height (ft): 1.59
MP Description: Top PVC Ground Surface Elevation (ft): 3070.862
MP Height Above or Below Ground (ft): 1.59 MP Elevation (ft): 3072.45

Remarks: Direct Pushed to 16'. Completed 3/4" well inside of 2 1/8" rods. Used 2 1/2" outside diameter steel knock off plug at bottom. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 sand pack is 8.5'-16'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silt w/ Fine Sand**
dty; pale yellowish brown; soft loose roots

4.0 - 8.0' **Silt, Sand Gravel**
dry; pale yellowish brown; w/ multicolored (brown to reddish brown) sub-angular to sub-rounded clincker gravels about 15% gravels up to 3/4" in size

8.0 - 12.0' **Sand and Gravel**
dry to slightly moist; medium yellowish brown; clinker and shale gravels, shale gravels at 10', gravels up to +1" in size

12.0 - 15.0' **Gravel**
dry; multicolored; clinker and sandstone in origin; large up to cobble sized; sub-angular to angular

15.0 - 16.0' **Clay**
moist; weathered claystone

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF8-P2

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 22, NW1/4; N 464789.38, E 2823283.66
Location Description:

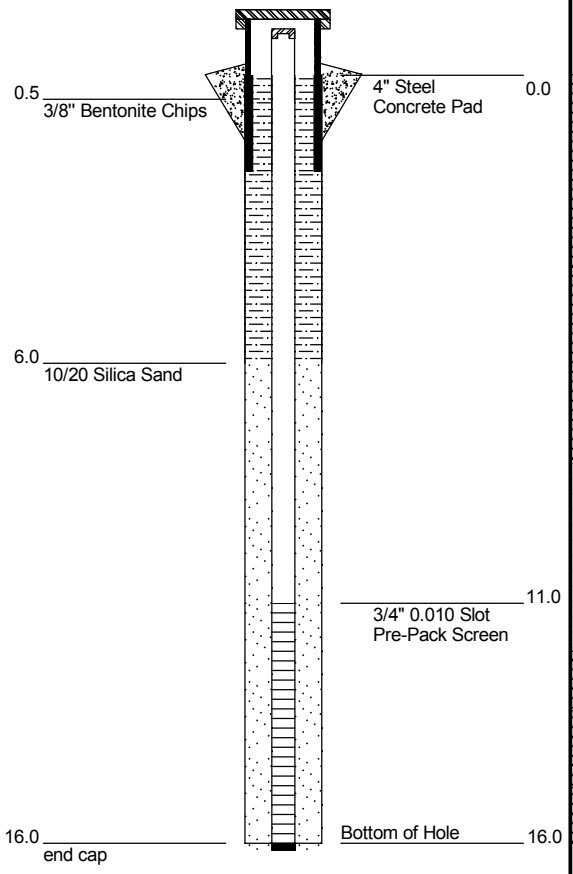
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4" (0'-2'); 2 1/8" (2'-16')
Total Depth Drilled (ft): 16

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4"-inch, flush threaded, Sch 40, PVC	+2.97-16
Surface Casing Used?	Y	4" steel	+2.97-2.03
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	11-16
Sand Pack?	Y	20/30 Silica Sand	6-16
Annular Seal?	Y	3/8 Bentonite Chips	+1-6
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 464789.386 Easting: 2823283.667
Static Water Level Below MP: Dry at 17.84' Surface Casing Height (ft): 2.97
Date: 8/28/2013 Riser Height (ft): 2.54
MP Description: Top PVC Ground Surface Elevation (ft): 3073.524
MP Height Above or Below Ground (ft): 2.54 MP Elevation (ft): 3076.06

Remarks: Direct Pushed pilot hole to 16', didn't tag gravel, installed 3/4" well to 16' in pilot hole. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 sand pack is 6'-16'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silt and Clay**
very dry; pale yellow to moderate yellowish brown; very dense; white salt precipitate; roots throughout

4.0 - 8.0' **Silty Clay**
as above; more coarse w/ depth

8.0 - 12.0' **Silty Sand**
dry to slightly moist; trace gravel <5%

12.0 - 16.0' **Sandy Clay**
slightly moist; moderate yellowish to moderate yellowish brown [10YR 4/4]

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF8-P3

Date Hole Started: 8/15/13 Date Hole Finished: 8/15/13

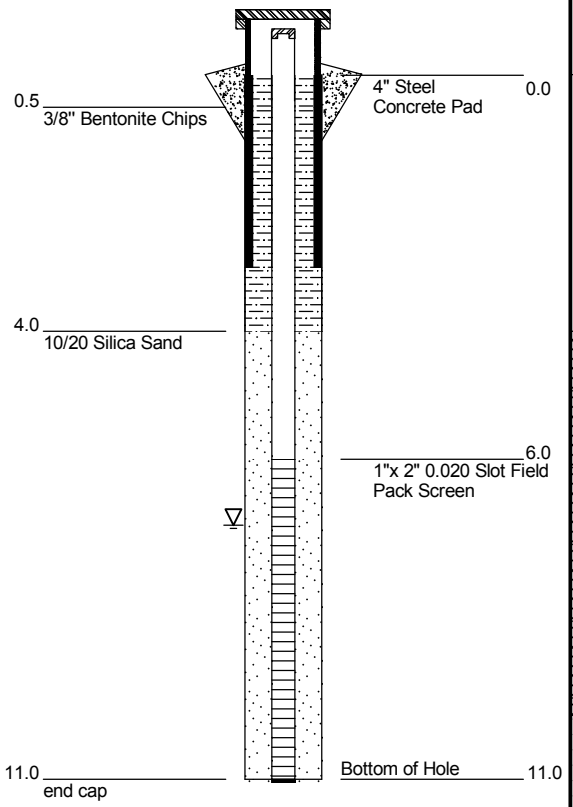
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 22, NE1/4; N 464492.40, E 2824386.72
Location Description:
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 11

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+1.90-11.8
Surface Casing Used?	Y	4" steel	+1.90-3.10
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	6-11
Sand Pack?	Y	10/20 Silica Sand	4-11
Annular Seal?	Y	3/8 Bentonite Chips	+1-4
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 464492.404 Easting: 2824386.727
Static Water Level Below MP: 8.61 Surface Casing Height (ft): 1.90
Date: 8/28/2013 Riser Height (ft): 1.58
MP Description: Top PVC Ground Surface Elevation (ft): 3060.353
MP Height Above or Below Ground (ft): 1.58 MP Elevation (ft): 3061.92

Remarks: Direct Pushed pilot hole to 12'. Tripped out and backfilled pilot hole with 3/8" bentonite chips. Moved ~ 3' and augered to 11'.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silt**
dry; pale yellowish brown [10YR 5/4]; soft; moderately loose, roots

4.0 - 10.0' **Silt to Clayey Sand**
dry to very moist; moderate yellowish brown; more clayey sand with depth

10.0 - 11.8' **Sandy Clay to Clayey Sand**
wet; moderate yellowish brown;

11.8 - 12.0' **Gravel**
1/4" clinker and sand poorly sorted

Hydrometrics, Inc.

Consulting Scientists and Engineers
Billings, Montana

Monitor Well Log

Hole Name: AVF8-P4

Date Hole Started: 8/16/13 Date Hole Finished: 8/16/13

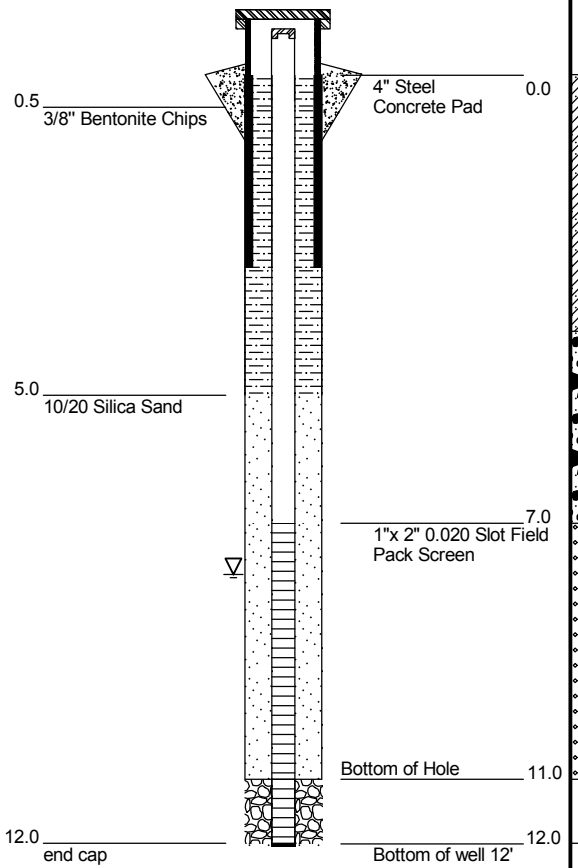
Client: Arch Coal
Project: Otter Creek Mine Permit (10068)
County: Powder River State: Montana
Property Owner: Great Northern Properties
Legal Description: T4S, R45E, Sec. 22, NE1/4; N 464810.33, E 2824900.74
Location Description:
Recorded By: RJL
Drilling Company: Hydrometrics, Inc
Driller: Larry Johnson and Carl Lanz
Drilling Method: Auger/ Direct Push
Drilling Fluids Used: None
Purpose of Hole: Install Monitor Well
Target Aquifer: Root Zone Ground Water
Hole Diameter (in): 6 1/4"
Total Depth Drilled (ft): 11

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	1-inch, flush threaded, Sch 40, PVC	+1.60-12
Surface Casing Used?	Y	4" steel	+1.88-3.22
Screen/Perforations?	Y	0.020-inch slot, 1"x 2" field pack	7-12
Sand Pack?	Y	10/20 Silica Sand	5-11
Annular Seal?	Y	3/8 Bentonite Chips	+1-5
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 464810.332 Easting: 2824900.743
Static Water Level Below MP: 9.40 Surface Casing Height (ft): 1.88
Date: 8/28/2013 Riser Height (ft): 1.60
MP Description: Top PVC Ground Surface Elevation (ft): 3060.169
MP Height Above or Below Ground (ft): 1.60 MP Elevation (ft): 3061.77

Remarks: Direct Pushed pilot hole to 11'. Tripped out and augered to 11'. Well pushed in and completed at 12' below ground surface due to soft clay.

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 4.0' **Silt, Sand and Clay**
dry to slightly moist; pale to moderate yellowish brown; loose, roots

4.0 - 7.0' **Sand and Gravel**
dry to slightly moist; pale reddish brown to moderate yellowish brown; multicolored gravels sub-angular to 3/4"

7.0 - 11.0' **Sandy Clay to Clayey Sand**
very moist to wet; very soft, loose; less clay to no clay at 10' - 12' and fine to moderately fine

11.0 - 12.0' **No Core Logged**
well advanced passed the drilled depth into soft clay

Hydrometrics, Inc.

Consulting Scientists and Engineers

Billings, Montana

Monitor Well Log

Hole Name: AVF8-P5

Date Hole Started: 8/16/13 Date Hole Finished: 8/16/13

Client: Arch Coal

Project: Otter Creek Mine Permit (10068)

County: Powder River State: Montana

Property Owner: Great Northern Properties

Legal Description: T4S, R45E, Sec. 22, NE1/4; N 465061.70, E 2825528.65

Location Description:

Recorded By: RJL

Drilling Company: Hydrometrics, Inc

Driller: Larry Johnson and Carl Lanz

Drilling Method: Auger/ Direct Push

Drilling Fluids Used: None

Purpose of Hole: Install Monitor Well

Target Aquifer: Root Zone Ground Water

Hole Diameter (in): 6 1/4" (0'-3'); 2 1/8" (3'-16')

Total Depth Drilled (ft): 14

WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	3/4"-inch, flush threaded, Sch 40, PVC	+2.36-14
Surface Casing Used?	Y	4" steel	+2.36-2.64
Screen/Perforations?	Y	0.010-inch slot, 3/4" pre-pack	9-14
Sand Pack?	Y	20/30 Silica Sand	9-14
Annular Seal?	Y	3/8 Bentonite Chips	+1-3
Surface Seal?	Y	Concrete Pad	
DEVELOPMENT/SAMPLING			
Well Developed?	Y	Peristaltic Pump	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: 465061.707 Easting: 2825528.645

Static Water Level Below MP: Dry at 16.15' Surface Casing Height (ft): 2.36

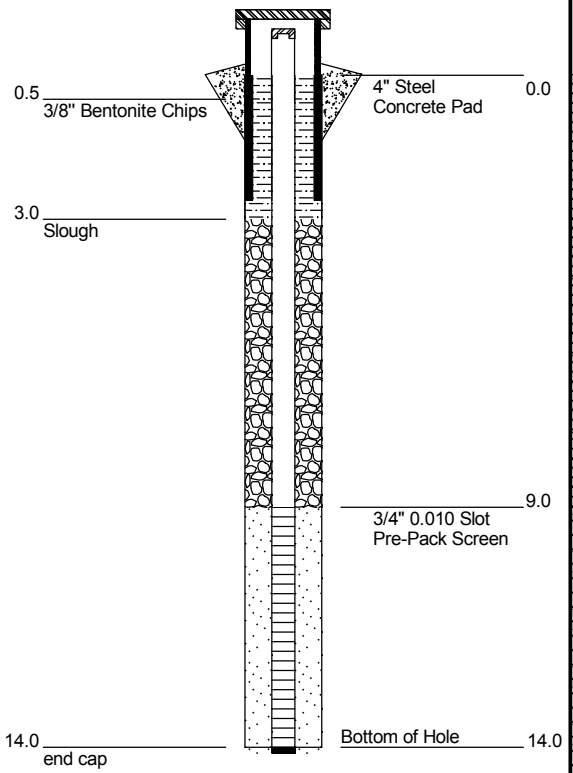
Date: 8/28/2013 Riser Height (ft): 2.24

MP Description: Top PVC Ground Surface Elevation (ft): 3067.358

MP Height Above or Below Ground (ft): 2.24 MP Elevation (ft): 3069.59

Remarks: Direct Pushed pilot hole to 16'. Tripped out and augered hole for steel casing to 3' with 6 1/4" auger. Directed pushed well hole to 14'. Installed 3/4" well at 14'. Used 10/20 silica sand to fill in around the 3/4 inch pre-pack screen. Interval for 10/20 pre-pack is 9'-14', hole sloughed from 3'-9',

WELL CONSTRUCTION



GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 3.0' **Silty Clay**
dry to slightly moist; moderate to dark yellowish brown; loose, roots

3.0 - 9.0' **Silty Sandy Clay**
slightly moist; moderate yellowish brown; moderate plasticity; loose

9.0 - 16.0' **Clayey Sand and Sandy Clay**
slightly moist to very moist w/ depth; soft, loose

STANDARD_REV3 OTTER CREEK WELL LOGS.GPJ HYDHLN2.GDT 10/6/14

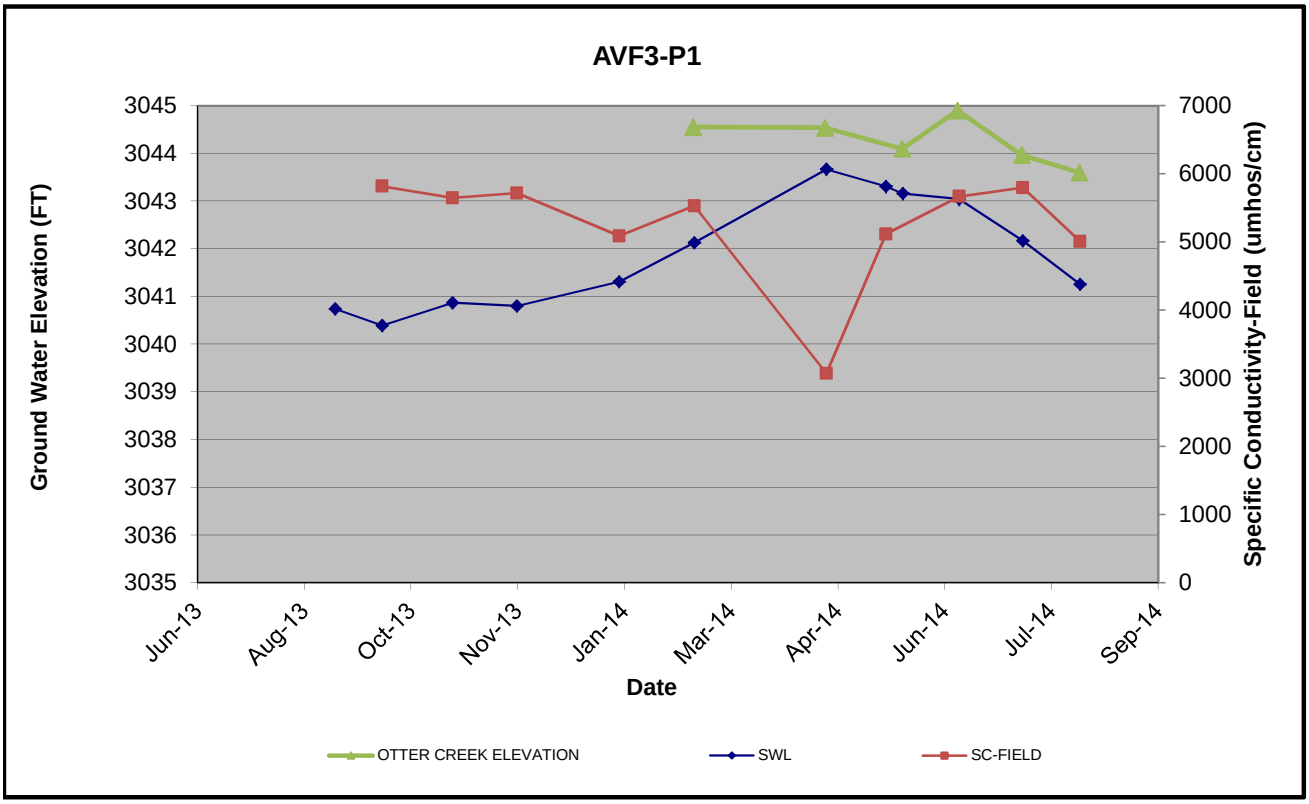
APPENDIX B

PIEZOMETER WATER LEVEL AND FIELD SC SUMMARY

APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF3-P1**
Measuring Point Elevation:	**3051.69**
Ground Surface Elevation:	**3050.07**
Completion Date:	**08/15/13**
Initial Static Water Level:	**10.95**

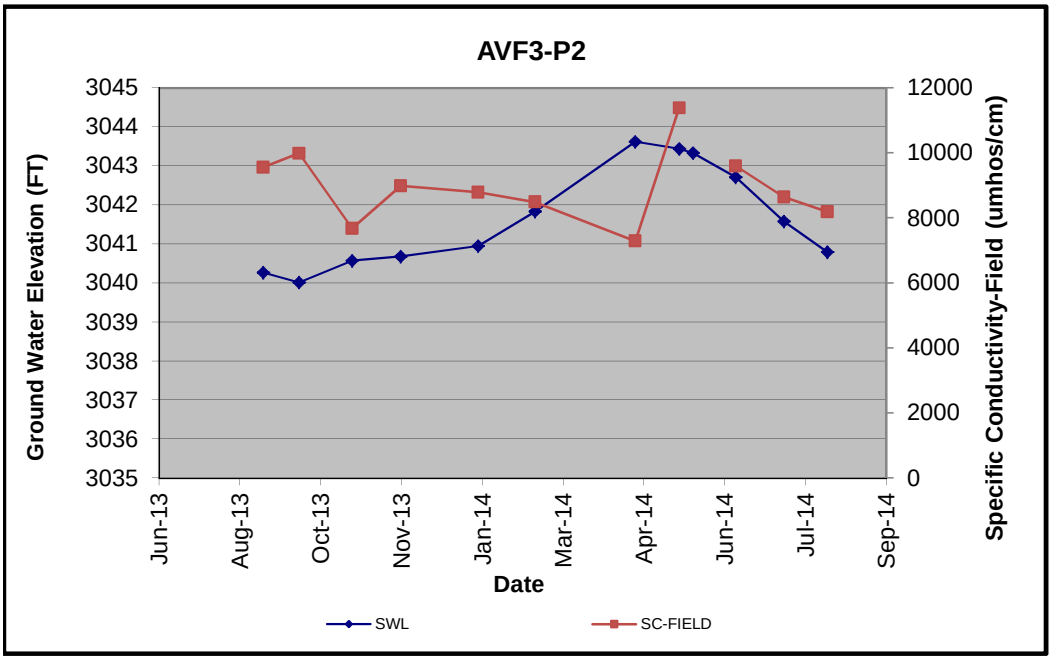
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	OTTER CREEK ELEVATION
08/28/13	10:40	41514.44	10.95	3040.74		
09/19/13	12:15	41536.51	11.30	3040.39	5820	
10/22/13	9:43	41569.40	10.82	3040.87	5650	
11/21/13	12:30	41599.52	10.89	3040.80	5720	
01/08/14	11:10	41647.47	10.38	3041.31	5090	
02/12/14	14:25	41682.60	9.56	3042.13	5530	3044.55
04/15/14	12:30	41744.52	8.02	3043.67	3070	3044.54
05/13/14	9:30	41772.40	8.38	3043.31	5120	
05/21/14	9:39	41780.40	8.53	3043.16		3044.10
06/16/14	15:55	41806.66	8.65	3043.04	5670	3044.90
07/16/14	12:02	41836.50	9.52	3042.17	5800	3043.97
08/12/14	8:30	41863.35	10.43	3041.26	5010	3043.60



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF3-P2**
Measuring Point Elevation:	**3047.04**
Ground Surface Elevation:	**3045.33**
Completion Date:	**08/15/13**
Initial Static Water Level:	**6.77**

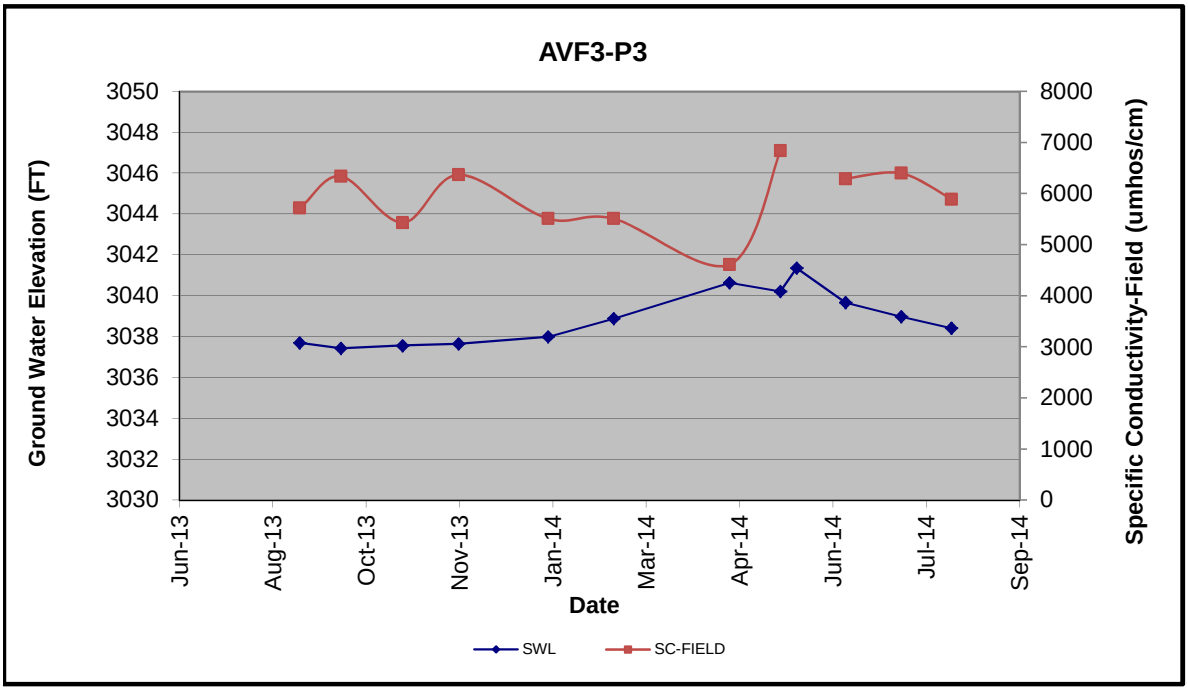
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD
08/28/13	10:00	41514.42	6.77	3040.27	9560
09/19/13	11:45	41536.49	7.03	3040.01	9990
10/22/13	10:46	41569.45	6.47	3040.57	7680
11/21/13	11:40	41599.49	6.36	3040.68	8990
01/08/14	10:35	41647.44	6.09	3040.95	8790
02/12/14	12:40	41682.53	5.21	3041.83	8490
04/15/14	14:20	41744.60	3.42	3043.62	7290
05/12/14	18:25	41771.77	3.60	3043.44	11390
05/21/14	10:16	41780.43	3.71	3043.33	
06/16/14	17:50	41806.74	4.33	3042.71	9600
07/16/14	11:30	41836.48	5.46	3041.58	8640
08/12/14	10:10	41863.42	6.25	3040.79	8190



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF3-P3**
Measuring Point Elevation:	**3044.99**
Ground Surface Elevation:	**3043.64**
Completion Date:	**08/15/13**
Initial Static Water Level:	**7.29**

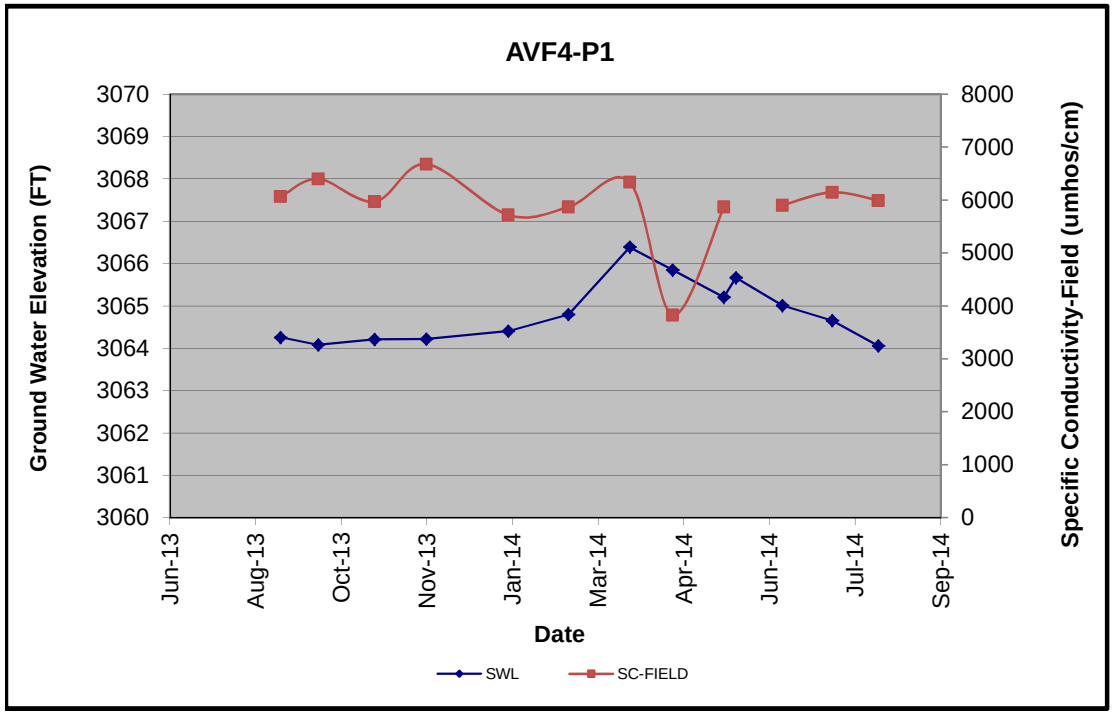
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD
08/28/13	9:55	41514.41	7.29	3037.70	5720
09/19/13	11:23	41536.47	7.57	3037.42	6340
10/22/13	10:58	41569.46	7.43	3037.56	5430
11/21/13	11:15	41599.47	7.35	3037.64	6370
01/08/14	10:00	41647.42	7.00	3037.99	5510
02/12/14	13:40	41682.57	6.11	3038.88	5510
04/15/14	14:50	41744.62	4.35	3040.64	4610
05/12/14	18:50	41771.78	4.77	3040.22	6840
05/21/14	10:12	41780.43	3.64	3041.35	
06/16/14	17:20	41806.72	5.32	3039.67	6290
07/16/14	11:07	41836.46	6.01	3038.98	6400
08/12/14	11:10	41863.47	6.58	3038.41	5890



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF4-P1**
Measuring Point Elevation:	**3077.01**
Ground Surface Elevation:	**3074.14**
Completion Date:	**08/16/13**
Initial Static Water Level:	**12.75**

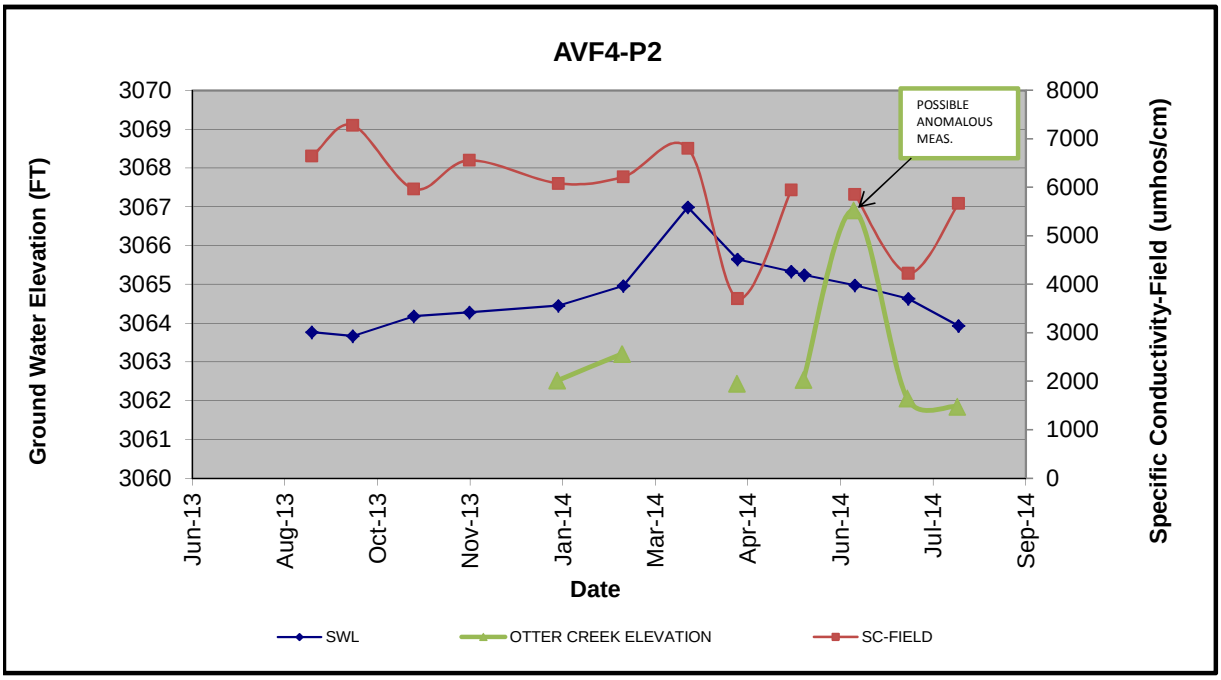
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD
08/28/13	13:45	41514.57	12.75	3064.26	6070
09/19/13	14:00	41536.58	12.93	3064.08	6400
10/22/13	12:30	41569.52	12.80	3064.21	5970
11/21/13	14:55	41599.62	12.79	3064.22	6680
01/08/14	13:03	41647.54	12.60	3064.41	5720
02/12/14	16:25	41682.68	12.21	3064.80	5870
03/20/14	10:00	41718.42	10.62	3066.39	6340
04/14/14	13:05	41743.55	11.16	3065.85	3830
05/14/14	8:30	41773.35	11.80	3065.21	5870
05/21/14	11:23	41780.47	11.34	3065.67	
06/17/14	14:20	41807.60	12.00	3065.01	5900
07/16/14	14:35	41836.61	12.35	3064.66	6150
08/12/14	14:40	41863.61	12.95	3064.06	5990



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF4-P2**
Measuring Point Elevation:	**3071.27**
Ground Surface Elevation:	**3069.49**
Completion Date:	**08/16/13**
Initial Static Water Level:	**7.50**

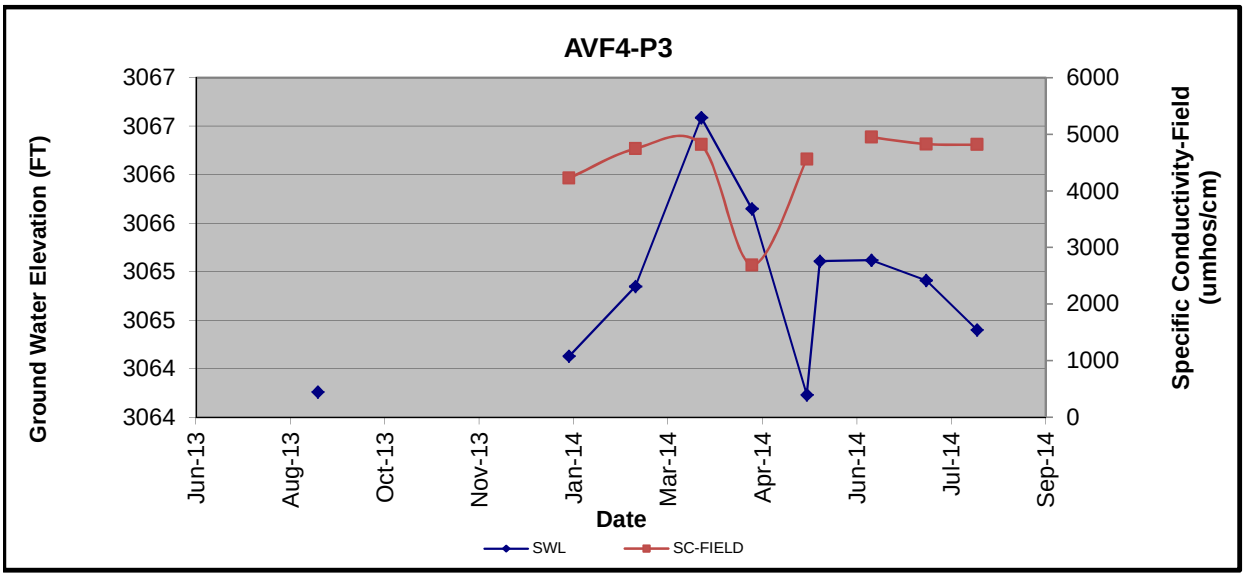
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	OTTER CREEK ELEVATION
08/28/13	13:45	41514.57	7.50	3063.77	6650	
09/19/13	14:20	41536.60	7.60	3063.67	7280	
10/22/13	12:50	41569.53	7.09	3064.18	5970	
11/21/13	15:10	41599.63	6.99	3064.28	6560	
01/08/14	13:30	41647.56	6.82	3064.45	6084	3062.52
02/12/14	16:00	41682.67	6.31	3064.96	6220	3063.21
03/19/14	13:30	41717.56	4.28	3066.99	6810	
04/15/14	8:15	41744.34	5.62	3065.65	3705	3062.44
05/14/14	9:45	41773.41	5.94	3065.33	5950	
05/21/14	11:41	41780.49	6.03	3065.24		3062.54
06/17/14	16:18	41807.68	6.29	3064.98	5860	*3066.91*
07/16/14	14:51	41836.62	6.64	3064.63	4230	3062.06
08/12/14	15:25	41863.64	7.34	3063.93	5670	3061.85



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF4-P3**
Measuring Point Elevation:	**3078.56**
Ground Surface Elevation:	**3075.86**
Completion Date:	**08/16/13**
Initial Static Water Level:	**14.80**

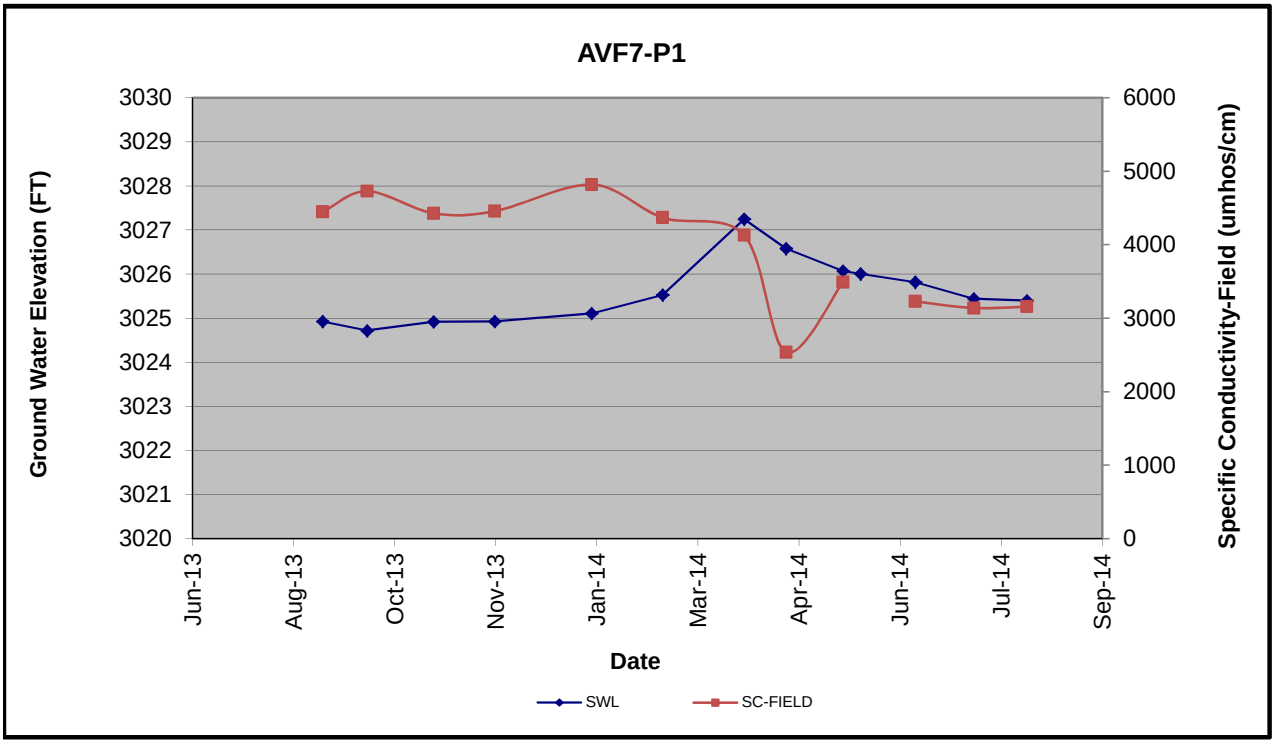
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	Comments
08/28/13	13:27	41514.56	14.80	3063.76		N/A
09/19/13	14:45	41536.61				DRY
10/22/13	13:17	41569.55				DRY @ 15.10
11/21/13	16:00	41599.67				DRY @ 14.82
01/08/14	13:10	41647.55	14.43	3064.13	4230	
02/12/14	15:50	41682.66	13.71	3064.85	4749	
03/19/14	13:15	41717.55	11.97	3066.59	4820	
04/15/14	7:58	41744.33	12.91	3065.65	2693	
05/14/14	10:05	41773.42	14.83	3063.73	4560	
05/21/14	12:00	41780.50	13.45	3065.11		
06/17/14	15:50	41807.66	13.44	3065.12	4950	
07/16/14	15:20	41836.64	13.65	3064.91	4830	
08/12/14	15:55	41863.66	14.16	3064.40	4820	



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF7-P1**
Measuring Point Elevation:	**3037.15**
Ground Surface Elevation:	**3035.06**
Completion Date:	**08/14/13**
Initial Static Water Level:	**12.22**

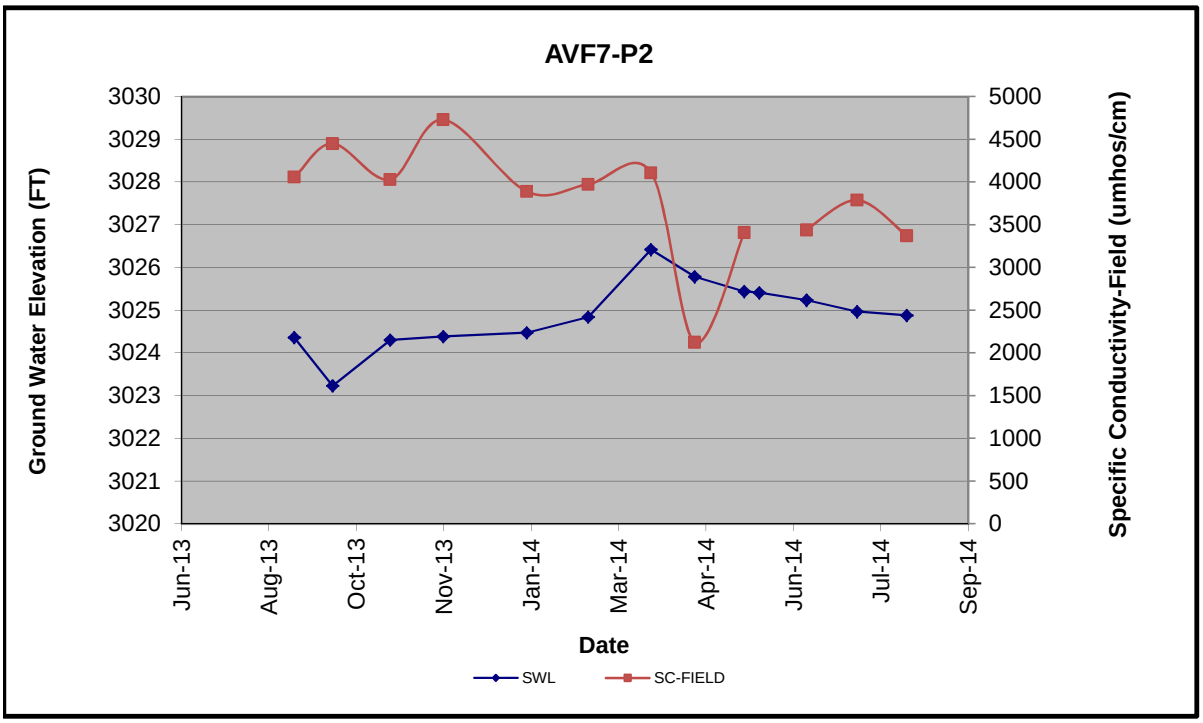
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD
08/28/13	9:50	41514.41	12.22	3024.93	4450
09/19/13	9:50	41536.41	12.43	3024.72	4730
10/22/13	7:55	41569.33	12.23	3024.92	4428
11/21/13	10:40	41599.44	12.22	3024.93	4458
01/08/14	9:00	41647.38	12.04	3025.11	4820
02/12/14	12:30	41682.52	11.62	3025.53	4369
03/24/14	19:20	41722.81	9.90	3027.25	4130
04/14/14	12:30	41743.52	10.57	3026.58	2539
05/12/14	15:45	41771.66	11.08	3026.07	3490
05/21/14	8:55	41780.37	11.14	3026.01	
06/17/14	11:20	41807.47	11.33	3025.82	3230
07/16/14	9:35	41836.40	11.71	3025.44	3140
08/11/14	16:30	41862.69	11.75	3025.40	3160



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF7-P2**
Measuring Point Elevation:	**3038.04**
Ground Surface Elevation:	**3035.33**
Completion Date:	**08/14/13**
Initial Static Water Level:	**13.68**

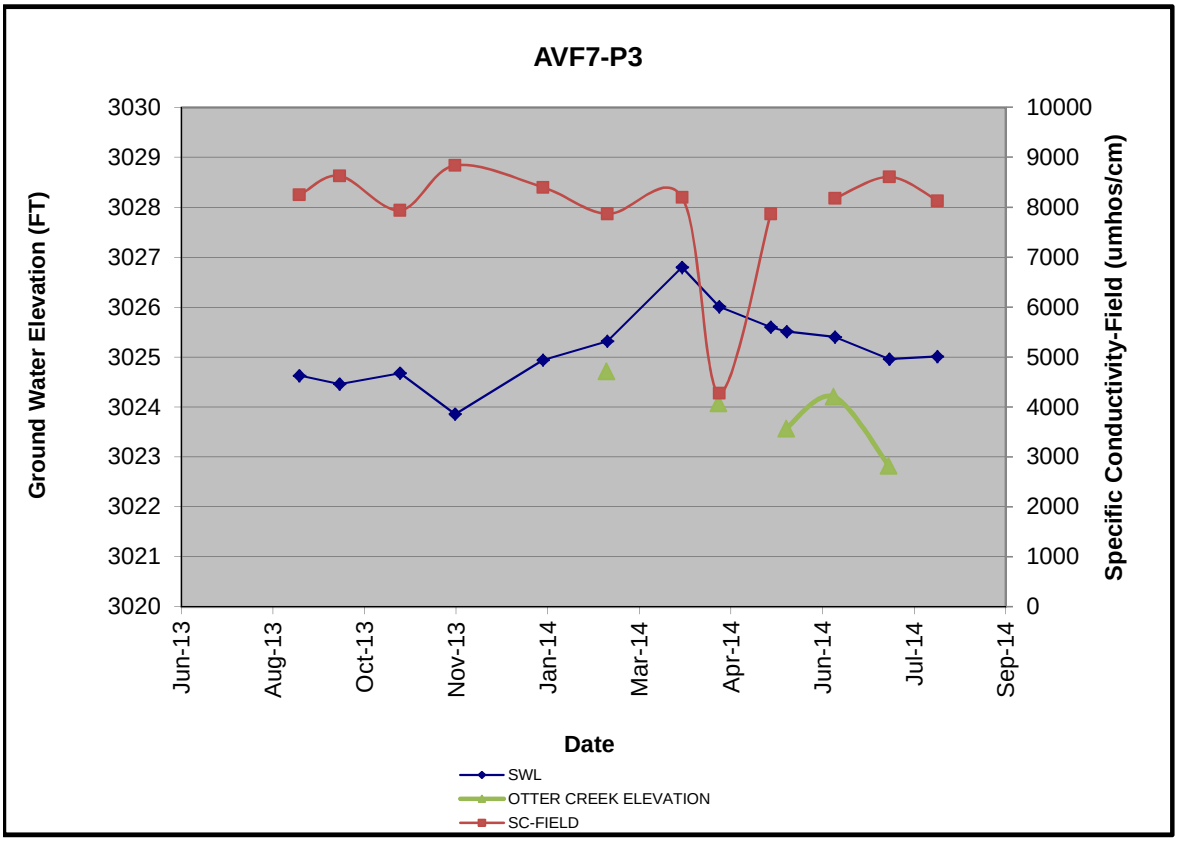
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD
08/28/13	9:50	41514.41	13.68	3024.36	4060
09/19/13	9:45	41536.41	14.81	3023.23	4450
10/22/13	7:35	41569.32	13.74	3024.30	4029
11/21/13	14:00	41599.58	13.66	3024.38	4730
01/08/14	9:25	41647.39	13.57	3024.47	3890
02/12/14	12:35	41682.52	13.20	3024.84	3974
03/20/14	11:15	41718.47	11.62	3026.42	4110
04/14/14	12:40	41743.53	12.26	3025.78	2125
05/12/14	19:45	41771.82	12.60	3025.44	3410
05/21/14	8:59	41780.37	12.63	3025.41	
06/17/14	11:40	41807.49	12.80	3025.24	3440
07/16/14	8:55	41836.37	13.07	3024.97	3790
08/13/14	16:00	41864.67	13.16	3024.88	3370



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF7-P3**
Measuring Point Elevation:	**3030.54**
Ground Surface Elevation:	**3029.09**
Completion Date:	**08/14/13**
Initial Static Water Level:	**5.91**

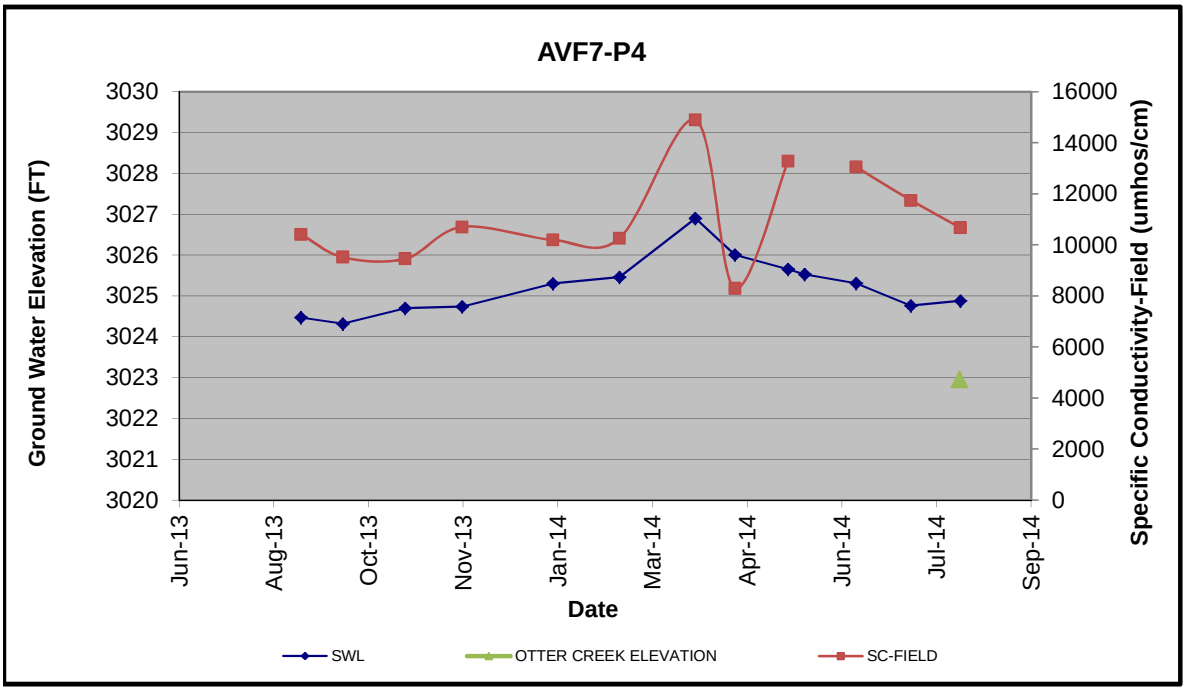
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	OTTER CREEK ELEVATION
08/28/13	8:50	41514.37	5.91	3024.63	8250	
09/19/13	10:05	41536.42	6.08	3024.46	8630	
10/22/13	8:05	41569.34	5.86	3024.68	7940	
11/21/13	9:35	41599.40	6.68	3023.86	8840	
01/08/14	8:45	41647.36	5.60	3024.94	8400	
02/12/14	12:25	41682.52	5.22	3025.32	7870	3024.72
03/25/14	7:20	41723.31	3.74	3026.80	8200	
04/14/14	12:00	41743.50	4.53	3026.01	4274	3024.08
05/12/14	14:45	41771.61	4.94	3025.60	7870	
05/21/14	8:42	41780.36	5.03	3025.51		3023.57
06/16/14	18:30	41806.77	5.14	3025.40	8180	3024.21
07/16/14	10:11	41836.42	5.58	3024.96	8610	3022.83
08/11/14	17:00	41862.71	5.53	3025.01	8130	



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF7-P4**
Measuring Point Elevation:	**3031.41**
Ground Surface Elevation:	**3029.12**
Completion Date:	**08/15/13**
Initial Static Water Level:	**6.94**

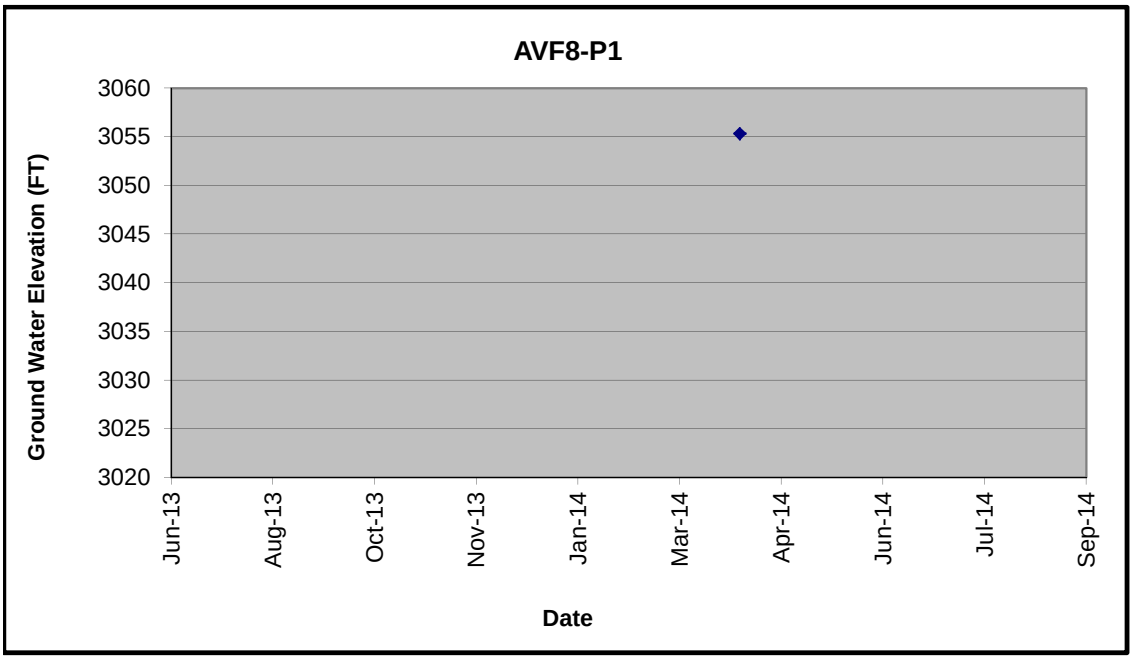
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	OTTER CREEK ELEVATION
08/28/13	8:00	41514.33	6.94	3024.47	10420	
09/19/13	10:20	41536.43	7.09	3024.32	9520	
10/22/13	9:06	41569.38	6.71	3024.70	9460	
11/21/13	10:00	41599.42	6.67	3024.74	10710	
01/08/14	8:20	41647.35	6.11	3025.30	10200	
02/12/14	12:20	41682.51	5.95	3025.46	10270	
03/24/14	15:00	41722.63	4.51	3026.90	14900	
04/14/14	10:45	41743.45	5.40	3026.01	8300	
05/12/14	13:00	41771.54	5.75	3025.66	13290	
05/21/14	8:32	41780.36	5.88	3025.53		
06/17/14	11:10	41807.47	6.10	3025.31	13060	
07/16/14	10:30	41836.44	6.65	3024.76	11750	
08/11/14	14:45	41862.61	6.53	3024.88	10680	3022.96



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	AVF8-P1
Measuring Point Elevation:	3072.45
Ground Surface Elevation:	3070.86
Completion Date:	08/15/13
Initial Static Water Level:	DRY @17.38

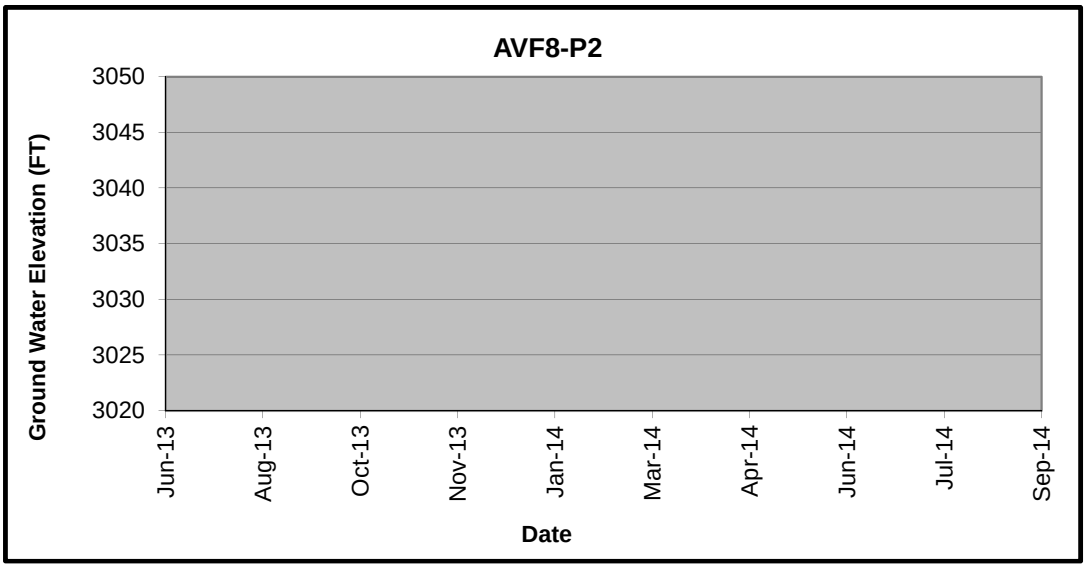
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	Comments
08/28/13	12:20	41514.51				DRY @ 17.38
09/19/13	13:25	41536.56				DRY @ 17.3
10/22/13	11:16	41569.47				DRY @ 17.56
11/21/13	13:28	41599.56				DRY @ 17.55
01/08/14	12:00	41647.50				DRY @ 17.55
02/12/14	15:32	41682.65				DRY @ 17.55
03/31/14	13:40	41729.57	17.13	3055.32		NOT ENOUGH H20
04/14/14	14:00	41743.58				DRY @ 17.38
05/13/14	16:13	41772.68				DRY @ 17.32
05/21/14	10:30	41780.44				DRY
06/16/14	12:45	41806.53				DRY @ 17.37
07/06/14	13:05	41826.55				DRY
08/12/14	13:55	41863.58				DRY @ 17.37



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF8-P2**
Measuring Point Elevation:	**3076.06**
Ground Surface Elevation:	**3073.52**
Completion Date:	**08/15/13**
Initial Static Water Level:	**DRY @ 17.84**

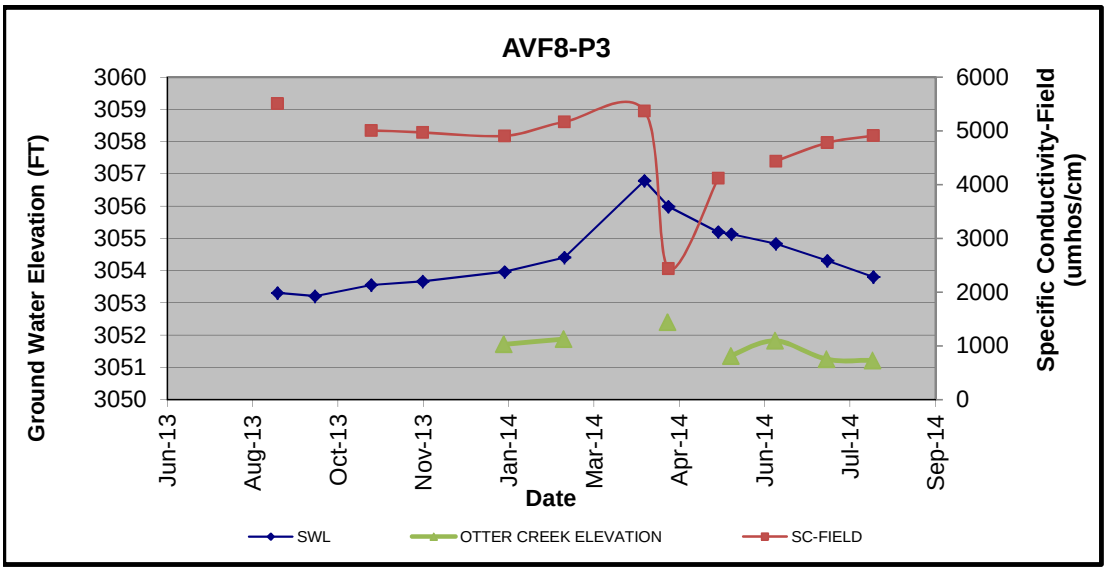
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	Comments
08/28/13	12:30	41514.52				DRY @ 17.84
09/19/13	13:28	41536.56				DRY @ 17.85
10/22/13	11:18	41569.47				DRY @ 18.23
11/21/13	13:33	41599.56				DRY @ 18.09
01/08/14	12:05	41647.50				DRY @ 18.09
02/12/14	15:34	41682.65				DRY @ 18.07
03/31/14	13:35	41729.57				DRY @ 18.10
04/14/14	14:05	41743.59				DRY @ 17.84
05/13/14	16:17	41772.68				DRY @ 17.85
05/21/14	10:33	41780.44				DRY
06/16/14	12:52	41806.54				DRY @ 17.85
07/16/14	13:40	41836.57				DRY
08/12/14	14:00	41863.58				DRY @ 17.85



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF8-P3**
Measuring Point Elevation:	**3061.92**
Ground Surface Elevation:	**3060.35**
Completion Date:	**08/15/13**
Initial Static Water Level:	**8.61**

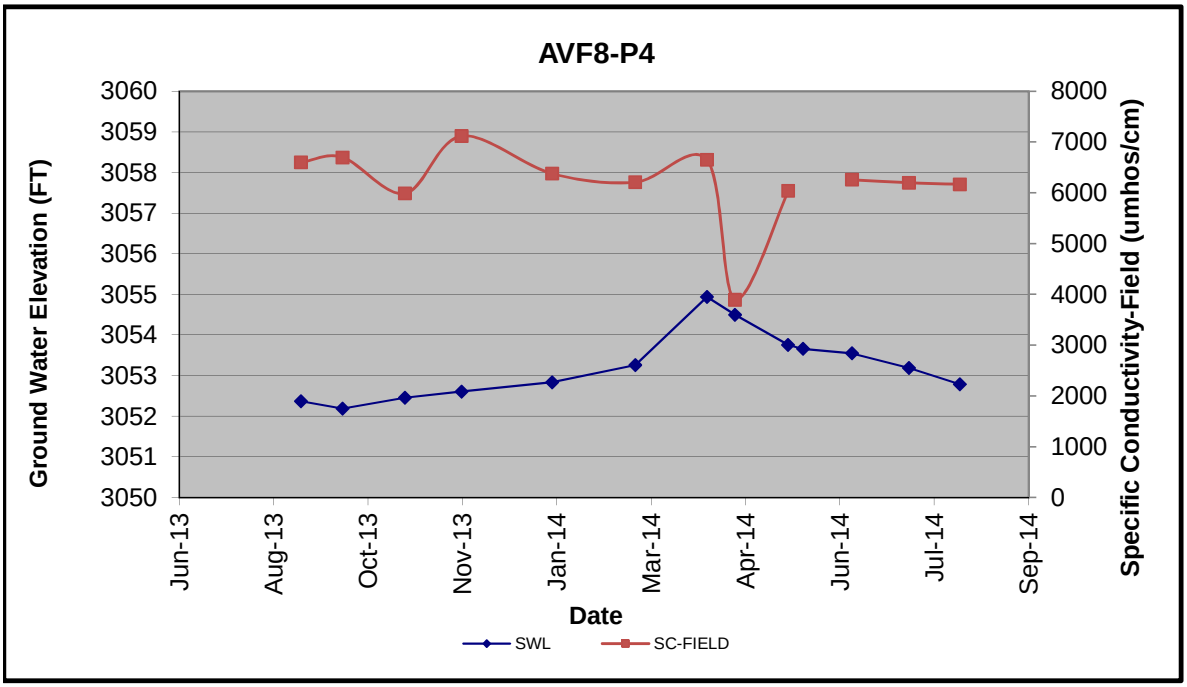
DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	OTTER CREEK ELEVATION
08/28/13	12:15	41514.51	8.61	3053.31	5510	
09/19/13	13:32	41536.56	8.71	3053.21		
10/22/13	11:27	41569.48	8.36	3053.56	5010	
11/21/13	14:00	41599.58	8.25	3053.67	4973	
01/08/14	12:10	41647.51	7.95	3053.97	4909	3051.72
02/12/14	15:10	41682.63	7.51	3054.41	5170	3051.88
03/31/14	13:30	41729.56	5.13	3056.79	5370	
04/14/14	14:30	41743.60	5.93	3055.99	2441	3052.41
05/13/14	16:00	41772.67	6.72	3055.20	4120	
05/21/14	10:39	41780.44	6.78	3055.14		3051.36
06/16/14	12:15	41806.51	7.08	3054.84	4440	3051.83
07/16/14	13:24	41836.56	7.61	3054.31	4780	3051.26
08/12/14	13:30	41863.56	8.11	3053.81	4911	3051.22



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	**AVF8-P4**
Measuring Point Elevation:	**3061.77**
Ground Surface Elevation:	**3060.17**
Completion Date:	**08/16/13**
Initial Static Water Level:	**9.40**

DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD
08/28/13	11:20	41514.47	9.40	3052.37	6600
09/19/13	13:00	41536.54	9.58	3052.19	6700
10/22/13	12:08	41569.51	9.31	3052.46	5990
11/21/13	13:20	41599.56	9.16	3052.61	7120
01/08/14	12:20	41647.51	8.93	3052.84	6380
02/21/14	14:44	41691.61	8.51	3053.26	6210
03/31/14	12:30	41729.52	6.83	3054.94	6650
04/15/14	10:50	41744.45	7.27	3054.50	3893
05/13/14	14:45	41772.61	8.01	3053.76	6040
05/21/14	11:02	41780.46	8.11	3053.66	
06/16/14	11:50	41806.49	8.22	3053.55	6260
07/16/14	12:55	41836.54	8.58	3053.19	6200
08/12/14	12:35	41863.52	8.98	3052.79	6170



APPENDIX B
OTTER CREEK MINE BASELINE REPORT 325A - APPENDIX I
PIEZOMETER WATER LEVELS AND FIELD SC SUMMARY

Well ID:	AVF8-P5
Measuring Point Elevation:	3069.59
Ground Surface Elevation:	3067.36
Completion Date:	08/16/13
Initial Static Water Level:	DRY @16.15

DATE	TIME	DATE/ TIME	SWL	SWL ELEVATION	SC-FIELD	Comments
08/28/13	11:05	41514.46				DRY @ 16.15
09/19/13	12:55	41536.54				DRY @ 16.15
10/22/13	12:18	41569.51				DRY @ 16.46
11/21/13	13:00	41599.54				DRY @ 16.16
01/08/14	12:08	41647.51				DRY @ 16.45
02/12/14	14:40	41682.61				DRY @ 16.41
03/31/14	11:30	41729.48	15.63	3053.96		
04/15/14	10:45	41744.45	15.89	3053.70	5230	
05/13/14	14:15	41772.59				DRY @ 16.17
05/21/14	10:59	41780.46				DRY
06/16/14	11:48	41806.49				DRY
07/16/14	12:50	41836.53				DRY @ 16.16
08/12/14	12:30	41863.52				DRY @ 16.17