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Transmittal Letter

To:
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Office of Federal and State Materials and
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United States Nuclear Regulatory Commission
Washington, DC 20555-0001

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File

From:
Rebecca D. Lindeman, P.E.

Date:
May 29, 2008

Subject:
Boner Property Well Report

ARCADIS Project No.:
B0085721.0002.00003

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Comments: Please find attached the Boner Property Well Report. Please let me know if you have any questions.

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Imagine the result

Exxon Mobil Environmental Services Corporation

FINAL

Boner Property Wells Summary

Highland Reclamation Project
Converse County, Wyoming

May 2008

ARCADIS

Rebecca Lindeman

Rebecca D. Lindeman, P.E.
Principal Civil Engineer

FINAL
Boner Property Well Summary

Highland Reclamation Project

Prepared for:
Exxon Mobil Environmental Services Corporation

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Our Ref.:
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1. Introduction

This monitoring well summary report has been prepared at the request of the Nuclear Regulatory Commission (NRC) to document offsite groundwater conditions east of the Highland Reclamation Project located near Douglas, Wyoming. This report summarizes the installation of three MFG wells and four BBL wells on the adjacent Boner property located to the east of the Pit Lake and Tailings Basin. This report also summarizes the analytical results for all the sampling events that have occurred since each well's inception. A summary of the geology and hydrogeology of the Site is provided below as reference for the newly-installed monitoring wells.

At the request of Exxon Mobil Environmental Services Corporation (EMES), Tetra Tech, formerly MFG, Inc., and ARCADIS, formerly BBL, installed monitoring wells on the adjacent Boner property to the east of the EMES Highland Reclamation Project. Seven groundwater monitoring wells were installed between 2005 and 2006. The purpose of the MFG and BBL well installation was to enable sampling of groundwater downgradient of the tailing basin into three different sandstone formations at the Site for the MFG wells (MFG-1, MFG-2, and MFG-3),two different subsurface units, alluvial material and the first water bearing bedrock formation, for the BBL wells (BBL-1, BBL-2, BBL-3, and BBL-4). The locations of the new monitoring wells are shown on Figure 1. A cross-section of the site, including these seven new wells, is presented in Figures 2 and 3.

1.1 Geology

The Site geology, also summarized in the *Final Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site* (MFG, 2007), is provided as reference for installation of the offsite wells. The geology of the Site consists of the sedimentary deposits within the Powder River Basin of northeastern Wyoming. The units of significance to this Site lay within the upper Fort Union Formation (Paleocene), and, to a lesser extent, the lower Wasatch Formation (Eocene). A stratigraphic column of these units is presented on Figure 4. Regionally, the strata dip towards the west (Hunter, 1999), but at the Site, dip is approximately 0.5 degrees to the northwest.

The Highland Sandstone Unit (HSU) of the Fort Union Formation is the host rock of most of the uranium ore in the area. The unit is 120 to 150 feet thick and consists of sand channel and floodplain facies (Hunter, 1999). The unit is divisible into three sandstone members that are separated by intervals of claystone and siltstone. Informal nomenclature refers to the sandstones from stratigraphically highest to lowest as 50-

Sand, 40-Sand, and 30-Sand, and the fine-grained intervals as 45-Shale and 35-Shale (Hunter, 1999). The sandstones have also been referred to as the upper, middle, and lower sandstone members (Exxon Research Production Company [EPRC], 1983). All three members are laterally extensive throughout the Site and are generally composed of fine- to medium-grained, poorly lithofied, arkosic sandstone that typically ranges from 20 to 50 feet in thickness. The fine-grained intervals are approximately 9 feet and 35 feet thick in the area of the Pit Lake, respectively, but, in some locations, are altogether absent, and the sandstones are in vertical contact (Hunter, 1999).

Overlying the HSU in the study area is the Tailings Dam Shale (TDSH), a laterally pervasive interval of siltstone and claystone that ranges from 20 feet to 50 feet in thickness. The TDSH is overlain by the Tailings Dam Sandstone (TDSS). The TDSS is composed of sand channel and floodplain facies similar to the sandstone members of the HSU and is typically 30 feet to 50 feet in thickness. Unlike the underlying deposits, the TDSS is not laterally extensive across the study area. This unit has a well-defined northwest-trending western edge approximately 1 mile west of the Pit Lake (Hunter, 1999). Along this line, the TDSS grades laterally to finer-grained siltstone and claystone. Overlying the TDSS is a thick sequence of interbedded sandstone, siltstone, and claystone of the upper Fort Union Formation and the lower Wasatch Formation.

The undifferentiated Fort Union and Wasatch deposits are exposed at the surface over the majority of the area. Because the strata dip to the northwest, and topography slopes to the southeast, depth to the TDSS, TDSH, and HSU decreases from northwest to southeast until these units eventually crop out in the eastern portion of the Site (east of the Tailings Dam) between the MFG well locations and the BBL well locations.

1.2 Hydrogeology

This section discusses the overall site hydrology. This is also summarized in the *Final Long Term Pit Lake and Groundwater Hydrology at the Highland Mine Site* (MFG, 2007).

The Site is located in a regional groundwater discharge area. Prior to mining activity at the Site, regional groundwater flowed through the upper Fort Union Formation strata from the west, north, and south, and was discharged at outcrops of these strata along North Fork Box Creek and its tributaries (Dames & Moore, 1980).

Beginning in 1972, Exxon Minerals Company/Exxon Coal and Minerals Company commenced mining operations at the Site that created a major disruption to the natural groundwater flow field. Surface or open-pit mine Pits 1 through 4 were sequentially excavated from 1972 to 1984 (Figure 1). During this time, total groundwater withdrawal from pit sumps and dewatering wells typically exceeded 1,000 gallons per minute (gpm). Following excavation, Pits 1 and 2 were backfilled with overburden materials, while Pits 3 and 4 remained open. In March 1984, dewatering of Pits 3 and 4 ceased, the Pit Lake began to fill, and the large cone of depression in the potentiometric surface began to recover.

The hydrogeology at the Site was also impacted by the placement of mill tailings in the unnamed tributary of North Fork Box Creek east of the surface mine operations (Figure 1). Tailings were deposited in this drainage beginning in 1972 and continued until the end of milling operations in June 1984. The deposition of tailings slurry over time created a groundwater mound beneath the impoundment. Waste, Water, and Land (WWL, 1984) estimated that flux from the tailings reached a maximum of approximately 180 gpm (34,500 cubic feet per day [ft^3/day]) in 1984 and decreased to 3.5 gpm (670 ft^3/day) by 1992.

A dam was constructed to the east of the Tailings Basin at the beginning of mining operations to prevent tailings from entering the valley located directly to the east. As discussed above, the deposition of tailings slurry over time created a groundwater mound beneath the tailings basin. Seepage of groundwater from beneath the tailings basin through the dam has been visually observed at the Site in the past in conjunction with the observation of unusually green grass. Seepage from the Tailings Dam has not been visually observed in many years.

2. Monitoring Well Installation, Pump Installation, and Sampling Procedures for MFG Wells

The monitoring well installation activities for the three MFG wells commenced on October 4, 2004 and were completed by October 7, 2004. The three wells were sampled on November 17, 2004. A summary of these activities were previously submitted internally on November 16, 2004 from Joe Reed to Clint Strachan, both of Tetra Tech (MFG, 2004). A copy of this memorandum was submitted to EMES on September 12, 2006 by ARCADIS. Information from this memorandum (MFG, 2004) is summarized below. Survey data is summarized in Table 1 and well completion information is summarized in Table 2. Appendix A contains monitoring well completion diagrams. Borehole logs are presented in Appendix B.

2.1 Monitoring Well Installation Procedures

Drilling Engineers Inc., of Fort Collins, Colorado installed three boreholes using a CME 75 drill rig utilizing hollow stem augers and air rotary drilling. Hollow stem augers (8.25-inch inside diameter and 12.25-inch outside diameter) were advanced to 15 feet below ground surface (bgs) and were then utilized as temporary surface casing. Air rotary drilling (using a 7 7/8-inch diameter roller bit) was then used to advance the boreholes to total depth. The boreholes were sampled during drilling by observation of drill cuttings.

The 4-inch diameter monitoring wells were constructed from Boart Longyear's Tilock Schedule 40 polyvinyl chloride (PVC). Slotted well screen (0.020-inch) and cap was installed at the depths specified in Table 2. A centralizer was installed in the middle of the screen interval of MFG-2 and MFG-3 and two centralizers were installed at the top and bottom of the screen interval of well MFG-1. Oglebay Norton Corporation's 10-20 filter pack was installed to 3-6 feet above the screen. A Cetco coated pelleted bentonite seal was installed above the filter pack. Chip bentonite was installed above the pelleted bentonite seal to near ground surface. The 4-inch diameter PVC was capped with a 4-inch diameter slip cap. The surface completion for each well consisted of a lockable protective steel casing with a sloping cement pad.

2.2 Monitoring Well Pump Installation and Development

Wells were first developed by surging and bailing throughout the screened interval. Grundfos 5SQ3A, ½ horsepower, 20 volt electric submersible pumps were installed in each of the monitoring wells by Pronghorn, Pump, and Repair (PPR) of Glenrock,

Wyoming. The pump was installed at 51 feet below ground surface (bgs) in MFG-1, at 90 feet bgs in MFG-2 and at 139 feet bgs in MFG-3.

PPR then further developed the wells by pumping. MFG-1 was pumped dry more than 30 times, 1,100 gallons was purged from MFG-2 and 1,800 gallons was purged from MFG-3. MFG-1 easily pumps dry but quickly recovers; MFG-2 and MFG-3 can be pumped continuously at 5 gallons per minute.

Development water and drill cutting were spread on the ground at the well site. All downhole drilling and development equipment was decontaminated by power washing with tap water and Liquinox prior to drilling the first borehole.

The monitoring wells are registered with the State of Wyoming and have been assigned the following permit numbers:

- MFG-1 Permit No. U.W. 162572
- MFG-2 Permit No. U.W. 162573
- MFG-3 Permit No. U.W. 162571

2.3 Initial Water Quality Analyses

Initial water quality samples were collected from the new wells on November 17, 2004. Quarterly groundwater sampling was implemented thereafter and is still ongoing. In November 2004 the three MFG wells were sampled for the Nuclear Regulatory Commission (NRC) Short List. The three wells have been sampled for the NRC Long List during the first and third quarters and for the NRC Short List during the second and fourth quarters since each well's inception.

3. Monitoring Well Installation, Pump Installation, and Sampling Procedures for BBL Wells

The monitoring well installation activities for the four BBL wells commenced on June 26, 2006 and were completed on July 8, 2006. Development of the new monitoring wells and pump installation occurred between July 13, 2006 and July 18, 2006. Quarterly groundwater sampling included analysis of Nuclear Regulatory Commission parameters as listed in the Procedures Manual (ARCADIS, 2008). These procedures and results were previously summarized in a memorandum entitled, "Monitoring Well Installation, ExxonMobil Highland Site," to EMES dated September 12, 2006 (BBL, 2006). Survey data is summarized in Table 1 and well completion information is summarized in Table 2. Appendix A contains monitoring well completion diagrams. Borehole logs are presented in Appendix B.

3.1 Monitoring Well Installation Procedures

Drilling Engineers Inc., of Fort Collins, Colorado installed boreholes using a CME 75 drill rig utilizing hollow stem augers and air rotary drilling. The crew decontaminated downhole drilling equipment by power washing with tap water prior to and following drilling activities.

The field geologist observed downhole soil conditions via drill cuttings and split spoons recovered during drilling activities. At the completion of the borehole, drill cuttings were spread on the ground surface at the well site. Borehole logs are presented in Appendix A.

BBl-1 was initially drilled with hollow stem augers to 30 feet below ground surface (bgs) and air rotary to 56.5 feet bgs. This borehole was subsequently abandoned due to caving sands. The abandoned BBL-1 borehole encountered an alluvial channel with a high conductivity alluvial sand deposit not encountered at other boreholes. This sand deposit was not encountered at the next BBL-1 location, which supports the conclusion that it is an alluvial sand and not a bedrock sand deposit. Abandoned BBL-1 (BBL-1 P&A) was sealed by filling with chip bentonite. BBL-1 was relocated 63 feet to the northwest.

BBL-1, which is the deepest well, was drilled using hollow stem augers/air rotary drilling. BBL-1 was completed in the first water bearing bedrock formation. A hollow stem auger (8 ¼-inch inside diameter and 12 ¼-inch outside diameter) was advanced to 67 ½-feet (bgs) at BBL-1 and was then utilized as temporary surface casing. Air

rotary drilling (using a 7 7/8-inch diameter Ken Claw Bullet Bit) was then used to advance the borehole to total well completion depth.

Three shallow monitoring wells were drilled using hollow stem augers: BBL-2, BBL-3, and BBL-4. The shallow monitoring wells were completed in the alluvial material overlying the bedrock. Hollow stem augers (6 ¼-inch inside diameter and 10 ¼-inch outside diameter) were advanced to total depth.

The 4-inch diameter monitoring wells were constructed from Schedule 40 PVC. Slotted well screens (0.020-inch) were installed at the depths specified in Table 2. Centralizers were installed at the top and bottom of the screen interval of monitoring well BBL-1. A bottom bentonite pellet seal was installed to 41.8 feet bgs in BBL-3 to minimize bedrock ground water entering the alluvial well. Filter pack sand (10-20) was installed to 4 to 9 feet above the screen of the four monitoring wells. A pelleted bentonite seal was installed above the filter pack in each monitoring well. Chip bentonite was installed above the pelleted bentonite seal to near ground surface. The top of each PVC opening was covered with a slip cap. The surface completion for each well consisted of a key-locked protective steel casing with a 3-foot square sloping cement pad.

The monitoring wells were installed with guidance from Wyoming Permit-By-Rule (Wyoming Department of Environmental Quality, 2000). Wyoming Department of Environmental Quality allows Permit-By-Rule installations for monitoring wells 4-inches or less in diameter.

3.2 Monitoring Well Pump Installation and Development

Grundfos 3-inch, 230 volt electric submersible pumps with single-phase motors were installed in each of the monitoring wells by Pronghorn Pump and Repair of Glenrock, Wyoming. Monitoring wells BBL-1 and BBL-4 contain ½ horsepower (hp), 5 gallons per minute (gpm) pumps. Monitoring wells BBL-2 and BBL-3 contain 1/3-hp, 5 gpm pumps. The pump was installed at 133 feet bgs in BBL-1, at 35 feet bgs in BBL-2, at 40 feet bgs in BBL-3, and at 40 feet bgs in BBL-4.

Pronghorn Pump and Repair developed the monitoring wells by pumping between 40 and 80 casing volumes per well until purge water was reasonably clear. BBL-1 was pumped for a total of 7 ¾ hours over three days at a rate of 5 gpm and 6.5 gpm. Due to their low flow rates, BBL-2, BBL-3, and BBL-4 were pumped dry and then allowed to recover before repeating the process at least twice. The process was complete in well BBL-2 after 5 days, in BBL-3 after 4 days, and in BBL-4 after 3 days.

Downhole development equipment consisted of dedicated electric submersible pumps and disposable bailers. Development water was released on the ground surface in the vicinity of the well site.

Following development activities, flow restrictors were installed at monitoring wells BBL-2, BBL-3, and BBL-4. BBL-2 received a 1-gpm dole valve, while BBL-3 and BBL-4 each received a 2 gpm dole valve.

These monitoring wells were permitted under Permit-by-Rule for the State of Wyoming.

3.3 Initial Water Quality Analyses

Initial water quality samples were collected from the new wells in July 2006. Quarterly groundwater sampling was implemented thereafter and is still ongoing. In July 2006 the four BBL wells were sampled for the NRC Long List of parameters in accordance with the Procedures Manual (ARCADIS, 2008). In November 2006, the four wells were sampled for the NRC Short List. In March 2007, the four wells were again sampled for the NRC Long List. Since August 2007, all four wells have been sampled quarterly for both the NRC Long List and the Wyoming Department of Environmental Quality (WDEQ) list in accordance with the Procedures Manual (ARCADIS, 2008).

4. Discussion

While there appears to be elevated levels of some constituents in the new wells, this groundwater is not used by the public. An evaluation of the data is currently being conducted to determine long-term concentrations and potential impacts. The evaluation will include a determination of whether the current groundwater monitoring data are consistent with the site groundwater model used in the Alternative Concentration Limit (ACL) application. For instance, the Point-of-Compliance well along the east site of the Tailings Basin (Monitoring Well 125) has an ACL for U-nat of 0.089 milligrams per liter (mg/l). The BBL wells, which are downgradient from Monitoring Well 125, have U-nat values which appear to be elevated but are less than the ACL and are generally declining with distance from the Tailings Basin. This behavior is consistent with geochemical modeling which predicts decreasing concentrations with distance from the Tailings Basin as natural attenuation occurs. Of course, other constituents will need to be included in the evaluation. In addition, it is possible that the proposed NRC boundary will need to be expanded to include the area to the south-east to encompass the new wells. It is anticipated that the review will be completed in the next few months.

5. References

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Tables

Table 1
Survey Data

Boner Property Wells Summary Report
EMES - Highlance Reclamation Project,
Converse County, Wyoming

Well ID	Northing	Easting	Latitude	Longitude	Elevation (Top of PVC)
MFG-1[1]	874029.53	414525.549	43°03' 53.51532"	105°29' 13.69021"	5117.827
MFG-2[1]	874038.33	414543.504	43°03' 53.60295"	105°29' 13.44878"	5116.744
MFG-3[1]	874047.28	414561.693	43°03' 53.69204"	105°29' 13.20420"	5115.079
BBL-1 P&A[2]	873682.75	415431.73	NA	NA	NA
BBL-1[2]	873723.37	415383.07	NA	NA	5094.40
BBL-2[2]	873510.60	415471.18	NA	NA	5093.03
BBL-3[2]	873158.74	415961.36	NA	NA	5087.56
BBL-4[2]	871969.39	417072.44	NA	NA	5068.64

Notes:
[1]Datum:WGS 84
[2]Datum: NAD83
NA - Not applicable.
P&A - Plugged and abandoned.
PVC - Polyvinyl chloride.

Table 2
Well Completion Summary

Boner Property Wells Summary Report
EMES - Highlance Reclamation Project,
Converse County, Wyoming

Well ID	Total Depth (ft bgs)	Open Hole (ft bgs)	Bottom of PVC (ft bgs)	Top of Screen (ft bgs)	Top of Filter Pack (ft bgs)	Top of Bentonite Pellets (ft bgs)	Top of Bottom Bentonite Seal (ft bgs)	PVC Stickup (ft ags)	Static Water Level* (ft bgs)
MFG-1	51.5	NA	50.9	20.5	14.5	10.5	NA	2.0	41.60
MFG-2	96.0	NA	92.0	76.6	72.7	68.0	93.0	2.0	46.65
MFG-3	151.5	NA	140.6	130.2	127.0	121.5	NA	2.0	45.40
BBL-1	136.5	125.9	126.2	85.8	79.5	75.0	NA	2.0	(<24 hours after construction)
BBL-2	36.5	36.5	36.1	20.7	16.0	14.7	NA	2.0	27.40
BBL-3	44.5	42.0	40.2	24.8	15.5	14.8	41.8	2.0	23.40
BBL-4	39.6	39.6	39.6	14.2	10.3	8.6	NA	2.0	14.80

Notes:

* Static water level for MFG wells measure in November 2004 and for BBL wells on 7/8/06.

ft ags - Feet above ground surface.

ft bgs - Feet below ground surface.

Table 3
Groundwater Elevations

Boner Property Wells Summary Report
EMES - Highlands Reclamation Project,
Converse County, Wyoming

Date Measured	Well ID and Surface Elevation (ft amsl)						
	MFG-1 5115.83	MFG-2 5114.74	MFG-3 5113.08	BBL-1 5092.40	BBL-2 5091.03	BBL-3 5085.56	BBL-4 5066.64
	Depth to Groundwater (ft amsl)						
Nov-04	5073.94	5067.91	5069.48	NA	NA	NA	NA
Feb-05	5073.83	5067.71	5067.88	NA	NA	NA	NA
May-05	5073.71	5067.76	5067.76	NA	NA	NA	NA
Oct-05	5073.56	5067.71	5067.68	NA	NA	NA	NA
Dec-05	5073.44	5067.51	5067.53	NA	NA	NA	NA
Mar-06	5073.37	5067.36	5068.08	NA	NA	NA	NA
Jun-06	5073.29	5067.21	5067.31	NA	NA	NA	NA
Jul-06	NA	NA	NA	5064.07	5065.38	5063.87	5053.52
Aug-06	5073.19	5066.24	5067.52	NA	NA	NA	NA
Nov-06	5073.13	5067.04	5067.28	5063.97	5065.33	5063.81	5053.24
Mar-07	5073.02	5067.03	5067.51	5063.70	5065.28	5063.69	5053.34
May-07	5072.93	5066.94	5067.48	5064.20	5065.20	5062.66	5054.04
Aug-07	5072.95	5067.04	5067.28	5064.17	5065.13	5063.66	5053.21
Nov-07	5072.88	5066.82	5067.28	5064.06	5065.13	5063.76	5052.98
Average	**5073.32**	**5067.26**	**5067.70**	**5064.03**	**5065.24**	**5063.58**	**5053.39**

Notes:
ft amsl = feet above mean sea level
NA = Not measured. Wells not installed yet.

Table 4
Water Quality Data

Boner Property Wells Summary Report
EMES - Highlands Reclamation Project
Converse County, Wyoming

Analyte	Alkalinity to pH 8.3	Alkalinity to pH 4.5	As	Ca	Cd	Cl	Cr	Gross Alpha[1]	K	Mg	Na	Ni	NO2+NO3	Pb	pH	Ra226	Ra228	Se	SO4	TDS	Th230	U-Nat
Units			mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L			mg/L	mg/L	mg/L	mg/L	stnd	pCi/L	pCi/L	mg/L	mg/L	mg/L	pCi/L	mg/L
Reporting Reference Concentration	-	-	0.05		0.01	-	0.1	15	-	-	-	0.1	-	0.05	-	-	-	0.05	-	-	0.55	0.030
BBL - 1																						
7/25/2006	<0.46	179	<0.002	NS	<0.00025	3.4	0.00040 J	<1.0	NS	NS	68.0	0.0023	<0.10	<0.001	7.9	<0.2	<1.0	0.00051 J	92.6	328	<0.2	<0.0003
11/22/2006	NS	NS	NS	NS	NS	3.4	NS	NS	NS	NS	68.1	NS	<0.040	NS	7.9	NS	NS	NS	85.2	338	NS	NS
3/14/2007	NS	NS	0.00067	NS	0.000099	3.2	0.00029 J	<1.0	NS	NS	68.2	0.00098 J	<0.040	0.000047	7.9	<0.2	<1.0	0.0005	97.4	322	<0.2	<0.0003
6/4/2007	NS	NS	NS	NS	NS	3.4	NS	<1.0	NS	NS	59.6	NS	<0.040	NS	7.9	<0.2	<1.0	NS	84.9	329	<0.2	<0.0003
8/16/2007	<0.46	175	<0.00070	34.3	<0.000099	3.3	<0.00042	<1.0	4.76	7.6	68.9	0.0021	<0.040	0.00016J	7.9	<0.2	<1.0	<0.00053	88.1	340	<0.2	<0.0003
11/9/2007	<0.46	177	<0.00070	36.6	<0.000099	3.1	<0.00042	<1.0	5.11	7.87	65.1	0.0018J	<0.040	0.000053J	7.9	<0.2	<1.0	0.00056J	85.7	328	<0.2	<0.0003
3/15/2008	<0.46	173	<0.00070	35.2	<0.000099	3.4	<0.00060	<1.0	4.58	7.76	66.1	0.003	<0.040	0.000063J	7.8	0.4+/-0.2	<1.0	0.00070J	95.2	324	<0.2	<0.0003
BBL - 2																						
7/25/2006	<0.46	342	<0.0100	NS	<0.0013	145	0.0023 J	<1.0	NS	NS	135	0.0213	1.2	<0.001	7.3	<0.2	<1.0	0.0106	1,740	2,760	<0.2	**0.0624**
11/22/2006	NS	NS	NS	NS	NS	133	NS	NS	NS	NS	131	NS	0.040	NS	7.1	NS	NS	NS	1,560	2,680	NS	NS
3/14/2007	NS	NS	0.0019 J	NS	0.00028	104	0.00046 J	<1.0	NS	NS	131	0.0322	2.6	0.0013	7.6	<0.2	<1.0	0.0387	1,460	2,320	<0.2	**0.0554**
6/4/2007	NS	NS	NS	NS	NS	109	NS	2.1+/-0.9	NS	NS	114	NS	2.6	NS	7.2	0.7+/-0.3	<1.0	NS	1400	2530	<0.2	**0.0594**
8/16/2007	<0.46	321	0.0017J	458	<0.000099	118	0.00043J	1.3+/-0.7	5.92	113	133	0.0173	2.8	0.0014	7.3	<0.2	<1.0	0.0357	1330	2620	<0.2	**0.0595**
11/9/2007	<0.46	318	0.0043	483	0.00016J	104	<0.00042	<1.0	5.46	116	125	0.0188	3.3	0.002	7.3	<0.2	<1.0	0.0489	1380	2650	<0.2	**0.0629**
3/15/2008	<0.46	322	0.0015J	450	0.00015J	97.7	<0.00060	1.0+/-0.4	5.59	111	125	0.0739	3.1	0.00030J	7.2	<0.2	<1.0	**0.0501**	1420	2420	<0.2	**0.0567**
BBL - 3																						
7/26/2006	<0.46	482	<0.0100	NS	<0.0013	196	0.0025 J	2.2+/-0.8	NS	NS	147	0.0093 J	<0.10	<0.001	7.1	0.9+/-0.5	1.9+/-0.8	<0.0100	1,800	3,190	<0.2	**0.0513**
11/22/2006	NS	NS	NS	NS	NS	210	NS	NS	NS	NS	146	NS	<0.040	NS	7.0	NS	NS	NS	1670	3380	NS	NS
3/14/2007	NS	NS	0.002	NS	0.000099	206	0.00045 J	1.6+/-0.7	NS	NS	154	0.0205	<0.040	0.000047	7.1	0.7+/-0.3	2.4+/-1.0	0.0017 J	1890	3020	<0.2	**0.0510**
6/4/2007	NS	NS	NS	NS	NS	227	NS	2.9+/-0.9	NS	NS	140	NS	<0.040	NS	7.0	1+/-0.4	3.2+/-1.0	NS	1660	3250	<0.2	**0.0508**
8/16/2007	<0.46	472	0.0020J	573	<0.000099	222	<0.00042	3.1+/-0.9	9.63	156	150	0.0068	<0.040	0.00046J	7.0	0.7+/-0.3	3.2+/-0.9	0.0025	1650	3220	<0.2	**0.0482**
11/9/2007	<0.46	463	0.0026	578	<0.000099	224	<0.00042	1.8+/-0.6	9.27	166	138	0.0078	<0.040	0.00016J	7.0	0.6+/-0.3	8.3+/-1.2	0.0035	1860	3190	<0.2	**0.0525**
3/15/2008	<0.46	470	0.0025	599	<0.000099	240	<0.00060	2.3+/-0.5	9.52	164	142	0.0533	<0.040	0.00012J	7.0	0.8+/-0.2	3.3+-0.6	0.0031	1890	3020	<0.2	**0.0476**
BBL - 4																						
7/26/2006	<0.46	268	<0.0100	NS	<0.0013	175	0.0029 J	<1.0	NS	NS	125	0.0083 J	<0.10	0.00040 J	7.3	<0.2	<1.0	0.0148	1,500	2,790	<0.2	**0.0662**
11/22/2006	NS	NS	NS	NS	NS	167	NS	NS	NS	NS	124	NS	<0.040	NS	7.2	NS	NS	NS	1,460.00	2,880.00	NS	NS
3/14/2007	NS	NS	0.00067	NS	0.000099	151	0.00058 J	<1.0	NS	NS	120	0.0198	<0.040	0.000047	7.4	<0.2	<1.0	0.0046	1,490.00	2,320.00	<0.2	**0.0494**
6/4/2007	NS	NS	NS	NS	NS	160	NS	<1.0	NS	NS	98.1	NS	<0.040	NS	7.3	<0.2	<1.0	NS	1180	2260	<0.2	**0.0411**
8/16/2007	<0.46	213	<0.00070	393	<0.000099	156	<0.00042	<1.0	9.42	96.3	112	0.0106	<0.040	0.00072J	7.2	<0.2	<1.0	0.0025	1160	2260	<0.2	**0.0396**
11/9/2007	<0.46	215	<0.00070	423	<0.000099	152	<0.00042	<1.0	9.05	103	106	0.0125	<0.040	0.00020J	7.3	<0.2	<1.0	0.0032	1360	2190	<0.2	**0.0451**
3/26/2008	<0.46	210	<0.00070	418	<0.000099	175	<0.00060	1.3+/-0.4	9.11	100	111	0.0095	<0.040	0.00011J	7.1	0.2+/-0.1	<1.0	0.0014J	1340	2180	<0.2	**0.0365**
Blind Duplicate (to BBL-1)																						
7/25/2006	<0.46	176	<0.002	NS	<0.00025	3.4	0.00037 J	<1.0	NS	NS	68.7	0.0024	<0.10	<0.0010	7.9	<0.2	<1.0	<0.002	87.7	385	<0.2	<0.0003
11/22/2006	NS	NS	NS	NS	NS	3.4	NS	NS	NS	NS	65.4	NS	<0.10	NS	8	NS	NS	NS	93.1	349	NS	NS
3/14/2007	NS	NS	<.002	NS	<0.00025	3.1	0.00033J	<1.0	NS	NS	65.4	0.0012J	<0.10	<0.0010	7.9	<0.2	<1.0	<0.002	87.9	330	<0.2	<0.0003
6/4/2007	NS	NS	NS	NS	NS	3.4	NS	<1.0	NS	NS	63.9	NS	<0.1	NS	7.8	<0.2	<1.0	NS	86.1	331	<0.2	<0.0003
11/9/2007	<0.46	175.00	<0.00070	38.50	<0.000099	3.00	<0.00042	<1.0	5.10	8.19	63.70	0.00	<0.040	0.00010J	8.00	<0.2	2.00	<0.00053J	85.90	336	<0.2	<0.0003

Table 4
Water Quality Data

Boner Property Wells Summary Report
EMES - Highlands Reclamation Project
Converse County, Wyoming

Analyte	Alkalinity to pH 8.3	Alkalinity to pH 4.5	As	Ca	Cd	Cl	Cr	Gross Alpha[1]	K	Mg	Na	Ni	NO2+NO3	Pb	pH	Ra226	Ra228	Se	SO4	TDS	Th230	U-Nat
Units			mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L			mg/L	mg/L	mg/L	mg/L	stnd	pCi/L	pCi/L	mg/L	mg/L	mg/L	pCi/L	mg/L
Reporting Reference Concentration	-	-	0.05		0.01	-	0.1	15	-	-	-	0.1	-	0.05	-	-	-	0.05	-	-	0.55	0.030
MFG - 1																						
11/17/2004	NS	NS	NS	NS	NS	360	NS	NS	NS	NS	261	NS	0.883	NS	6.4	NS	NS	NS	2410	4450	NS	NS
2/24/2005	NS	NS	0.00531	NS	<0.0005	300	0.00109	<1	NS	NS	258	0.0139	<0.5	<0.001	6.6	0.5+/-0.4	<1	<0.001	2020	4460	<0.2	**0.362**
5/27/2005	NS	NS	NS	NS	NS	300	NS	NS	NS	NS	234	NS	0.556	NS	6.6	NS	NS	NS	2090	4260	NS	NS
10/3/2005	NS	NS	<0.002	NS	<0.001	300	<0.002	1.9+/-0.9	NS	NS	206	0.0132	0.517	<0.002	6.6	0.9+/-0.4	<1	<0.002	2560	2190	<0.2	**0.372**
12/19/2005	NS	NS	NS	NS	NS	280	NS	NS	NS	NS	251	NS	0.372	NS	6.6	NS	NS	NS	2300	4250	NS	NS
3/14/2006	NS	NS	0.00148	NS	<0.0005	300	<0.001	NS	NS	NS	245	0.0118	0.456	<0.001	6.5	NS	NS	<0.001	2370	4380	NS	NS
6/24/2006	NS	NS	NS	NS	NS	326	NS	NS	NS	NS	217	NS	0.47	NS	6.8	NS	NS	NS	2320	4030	NS	NS
8/18/2006	NS	NS	0.00067	NS	0.00	3.1	0.00089J	<1.0	NS	NS	221	0.0344	0.41	0.00061J	6.7	0.6+/-0.3	2.7+/-0.9	0.0017J	2240	3980	<0.2	**0.146**
11/22/2006	NS	NS	NS	NS	NS	313	NS	NS	NS	NS	242	NS	0.43	NS	6.8	NS	NS	NS	2020	4380	NS	NS
3/22/2007	NS	NS	0.00070J	NS	0.00	363	0.00052J	1.6+/-0.7	NS	NS	270	0.0286	0.31	0.00079J	6.7	<0.2	2.3+/-1.0	0.0022	2370	4520	<0.2	**0.298**
5/30/2007	NS		NS	NS	NS	337	NS	NS	NS	NS	209	NS	0.57	NS	6.5	NS	NS	NS	1940	4530	NS	NS
8/18/2007	NS	NS	<0.00070	NS	0.00	341	0.00051J	1.9+/-0.8	NS	NS	203	0.0256	0.67	0.0025	6.6	<0.2	2.7+/-0.9	0.0039	2040	4500	<0.2	**0.133**
11/8/2007	NS	NS	NS	NS	NS	341	NS	NS	NS	NS	269	NS	0.76	NS	6.6	NS	NS	NS	2110	3900	NS	NS
3/20/2008	NS	NS	<0.00070	NS	0.00023J	364	<0.0006	2.0+/-0.5	NS	NS	242	0.0234	1.0	0.00034J	6.7	0.3+/-0.1	1.7+/-0.5	0.0018J	2270	4220	<0.2	**0.355**
MFG - 2																						
11/17/2004	NS	NS	NS	NS	NS	160	NS	NS	NS	NS	164	NS	<0.5	NS	6.6	NS	NS	NS	2190	3770	NS	NS
2/24/2005	NS	NS	0.00359	NS	<0.0005	140	0.00101	2.8+/-1.3	NS	NS	162	0.00585	<0.5	<0.001	6.7	2.4+/-0.6	<1	<0.001	1840	3640	<0.2	0.0141
5/27/2005	NS	NS	NS	NS	NS	150	NS	NS	NS	NS	149	NS	<0.1	NS	6.8	NS	NS	NS	1910	3750	NS	NS
10/3/2005	NS	NS	<0.002	NS	<0.001	150	<0.002	6.5+/-1.4	NS	NS	148	0.00584	<0.1	<0.002	6.7	3.2+/-0.6	3.4+/-1.4	<0.002	2340	3760	<0.2	0.0103
12/19/2005	NS	NS	NS	NS	NS	150	NS	NS	NS	NS	160	NS	<0.1	NS	6.7	NS	NS	NS	2050	3870	NS	NS
3/14/2006	NS	NS	<0.001	NS	<0.0005	180	<0.001	NS	NS	NS	154	0.00459	<0.1	<0.001	6.6	NS	NS	<0.001	1980	3730	NS	NS
6/24/2006	NS	NS	NS	NS	NS	163	NS	NS	NS	NS	135	NS	<0.040	NS	6.9	NS	NS	NS	1820	3480	NS	NS
8/18/2006	NS	NS	< 0.00067	NS	<0.000099	1.6	0.00089J	2.7+/-1.2	NS	NS	154	0.0218	<0.040	<0.000047	6.9	2.3+/-0.5	4.6+/-1.0	0.0011J	1990	3670	<0.2	0.0100
11/22/2006	NS	NS	NS	NS	NS	159	NS	NS	NS	NS	140	NS	<0.040	NS	6.9	NS	NS	NS	1990	3460	NS	NS
3/22/2007	NS	NS	<0.00067	NS	0.00041J	181	0.00041J	3.1+/-0.8	NS	NS	164	0.0179	<0.040	<0.000047	6.8	1.9+/-0.5	3.1+/-1.0	0.0016J	1920	3490	<0.2	0.0092
5/30/2007	NS	NS	NS	NS	NS	166	NS	NS	NS	NS	135	NS	<0.040	NS	6.6	NS	NS	NS	1960	3570	NS	NS
8/18/2007	NS	NS	<0.00070	NS	0.00016J	172	<0.00042	2.9+/-0.9	NS	NS	154	0.0048	<0.040	0.00022J	7.8	1.5+/-0.4	5.1+/-0.9	0.0023	1930	3500	<0.2	0.0085
11/8/2007	NS	NS	NS	NS	NS	164	NS	NS	NS	NS	174	NS	<0.1	NS	6.7	NS	NS	NS	1860	3660	NS	NS
3/20/2008	NS	NS	<0.00070	NS	<0.000099	189	<0.0006	3.7+/-0.6	NS	NS	150	0.0182	<0.04	<0.00005	6.6	1.7+/-0.3	3.3+/-0.6	0.0011J	1990	3520	<0.2	0.0084
MFG-3																						
11/17/2004	NS	NS	NS	NS	NS	43	NS	NS	NS	NS	115	NS	<0.5	NS	7.1	NS	NS	NS	461	1110	NS	NS
2/23/2005	NS	NS	<0.001	NS	<0.0005	40	<0.001	2.2+/-1.2	NS	NS	116	<0.005	<0.5	<0.001	7.4	1.7+/-0.8	<1	<0.001	435	1050	<0.2	<0.0098
5/27/2005	NS	NS	NS	NS	NS	43	NS	NS	NS	NS	101	NS	<0.1	NS	7.2	NS	NS	NS	452	1070	NS	NS
10/3/2005	NS	NS	<0.002	NS	<0.001	34	<0.002	2.4+/-0.9	NS	NS	98.4	<0.002	<0.1	<0.002	7.4	1.1+/-0.4	<1	<0.002	496	994	<0.2	0.008
12/19/2005	NS	NS	NS	NS	NS	39	NS	NS	NS	NS	121	NS	<0.1	NS	7.4	NS	NS	NS	485	1140	NS	NS
3/14/2006	NS	NS	NS	NS	<0.0005	46	<0.001	NS	NS	NS	120	0.00162	<0.1	<0.001	7.2	NS	NS	<0.001	572	1090	NS	0.00115
6/24/2006	NS	NS	NS	NS	NS	50.4	NS	NS	NS	NS	101	NS	<0.040	NS	7.6	NS	NS	NS	536	1140	NS	NS
8/18/2006	NS	NS	<0.00067	NS	<0.000099	0.5	0.00091J	1.6+/-1.0	NS	NS	115	0.0065	<0.040	<0.000047	7.6	1.3+/-0.4	2.6+/-0.9	<0.00050	543	1110	<0.2	0.0068
11/22/2006	NS	NS	NS	NS	NS	55	NS	NS	NS	NS	113	NS	<0.040	NS	7.6	NS	NS	NS	569	1210	NS	NS
3/22/2007	NS	NS	<0.00067	NS	<0.000099	61	0.00038J	2.2+/-0.7	NS	NS	120	0.0056	<0.040	<0.000047	7.5	0.9+/-0.4	2.3+/-1.0	0.00063J	563	1130	<0.2	0.0065
5/30/2007	NS	NS	NS	NS	NS	60.2	NS	NS	NS	NS	121	NS	<0.040	NS	7.4	NS	NS	NS	630	1270	NS	NS
8/18/2007	NS	NS	<0.00070	NS	<0.000099	62	<0.0042	1.9+/-0.8	NS	NS	117	0.0052	<0.040	0.00013J	8	<0.2	2.9+/-0.9	0.00056J	631	1230	<0.2	0.0066
11/8/2007	NS	NS	NS	NS	NS	58.4	NS	NS	NS	NS	141	NS	<0.040	NS	7.4	NS	NS	NS	648	1320	NS	NS
3/20/2008	NS	NS	<0.00070	NS	<0.000099	65.6	<0.0006	2.2+/-0.5	NS	NS	129	0.0076	<0.04	0.00013J	7.3	0.8+/-0.2	1.5+/-0.5	<0.00099	726	1340	<0.2	0.0062

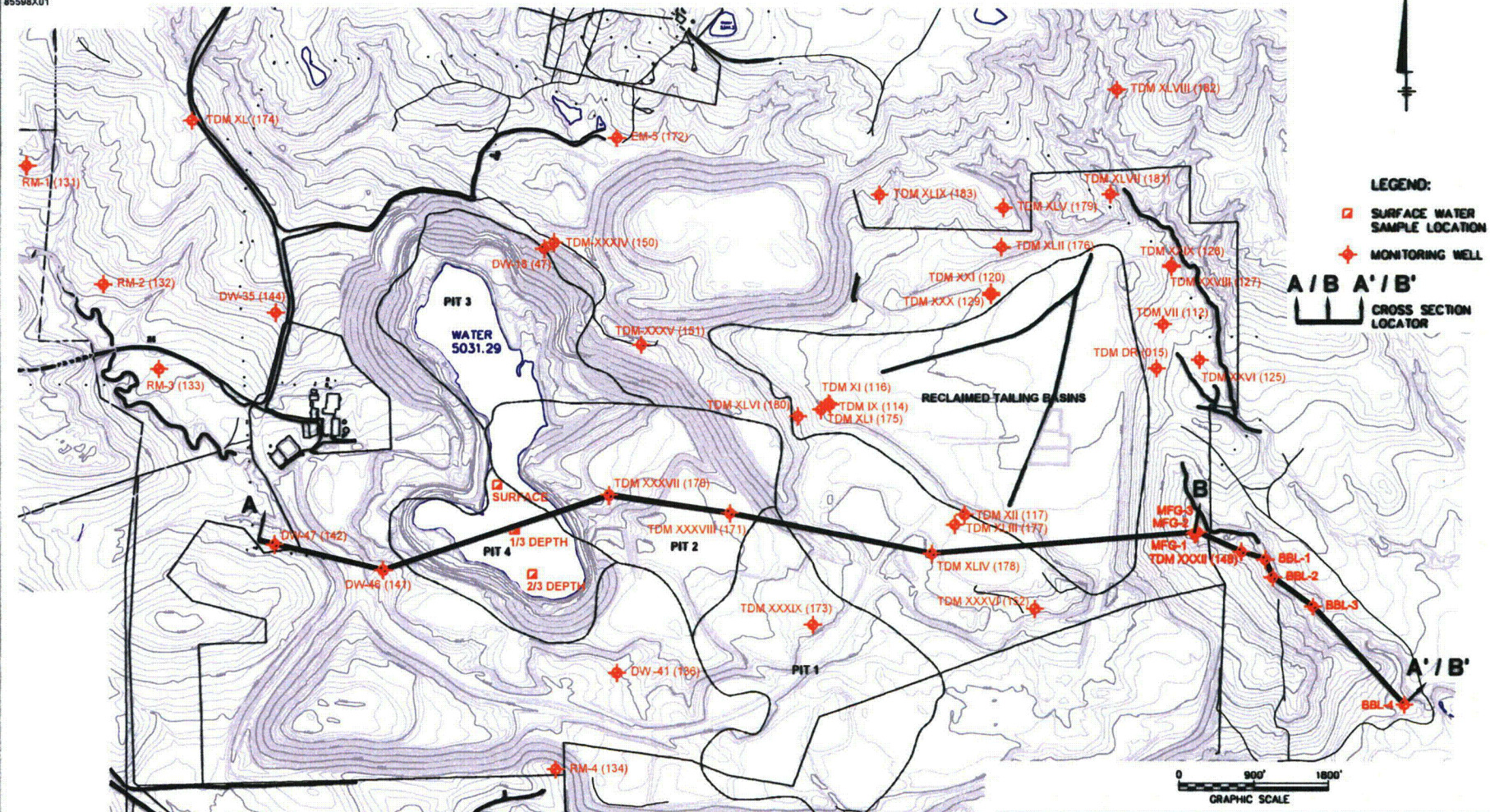
Notes:
[1] Gross Alpha measurement minus Radon and Uranium
J = The "J" qualifier is used to indicate a value the falls between the MDL (method detection limit) and LOQ (limit of quantitation). It denotes a detection of the analyte above zero however this value is considered an estimate.
NS = Not sampled for this analyte.
Bold = Concentrations exceeding the reporting reference concentration are bolded.
Shaded = The results for the shaded concentrations are thought to be in ug/L instead of mg/L but cannot be verified by the laboratory.

ARCADIS

Figures

CITY: SYRACUSE DIV/GROUP: 141/ENV DB: RCB RCA PIC: PM: H. OTTERSTETTER TM: LYR: ON=*,OFF=*REF*
G:\CADVACT\B0085721\0002\00003\DWG\BPWSR\85598B01.DWG LAYOUT: 1SAVED: 5/28/2008 7:34 AM ACADVER: 17.0S (LMS TECH) PAGESETUP: ---PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/28/2008 7:35 AM BY: ALLEN, ROYCE

XREFS: 85598X01 IMAGES: PROJECTNAME: ---

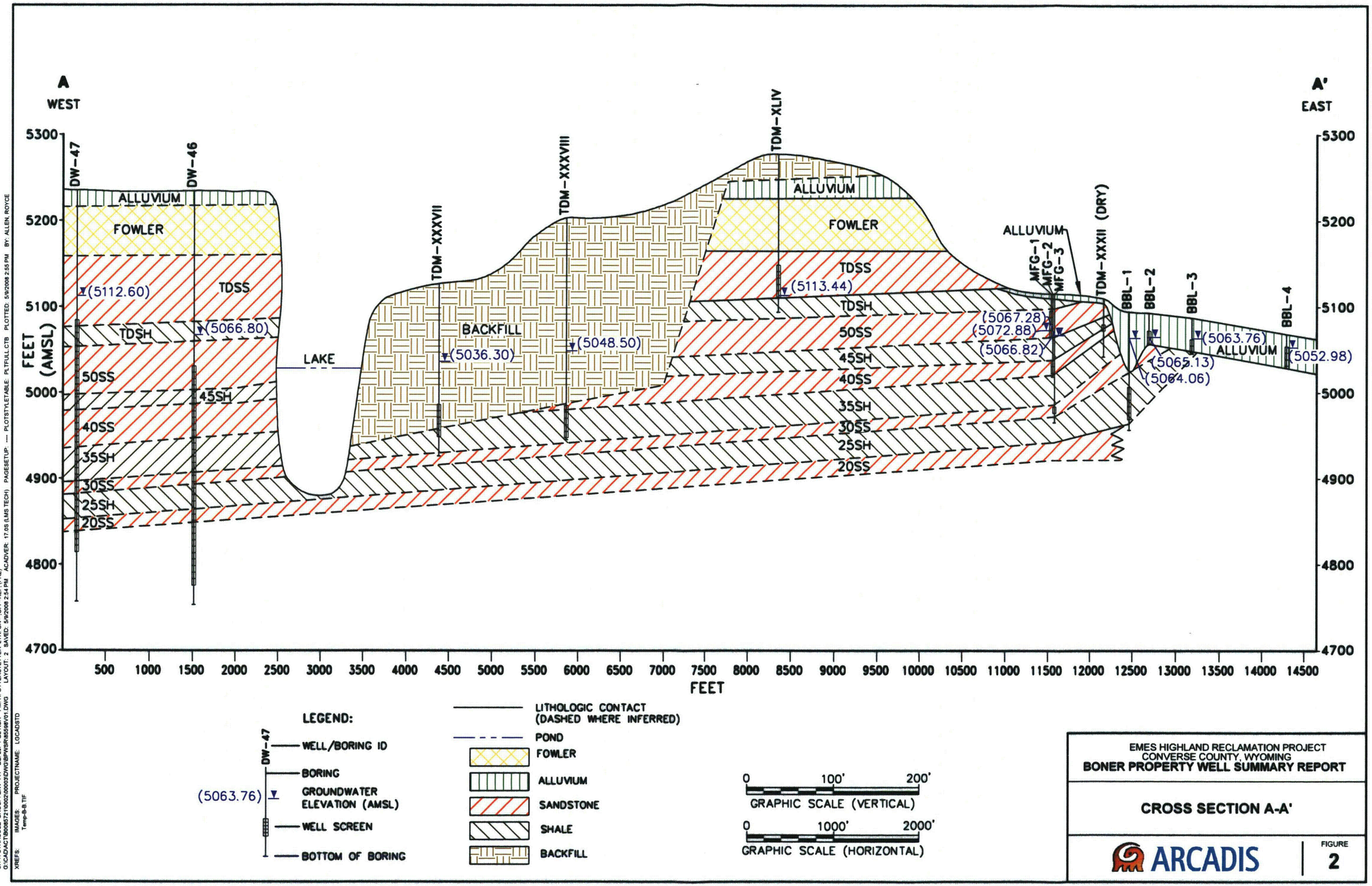


EMES HIGHLAND RECLAMATION PROJECT
CONVERSE COUNTY, WYOMING
BONER PROPERTY WELL SUMMARY REPORT

CROSS SECTION LOCATION MAP

ARCADIS

FIGURE
1



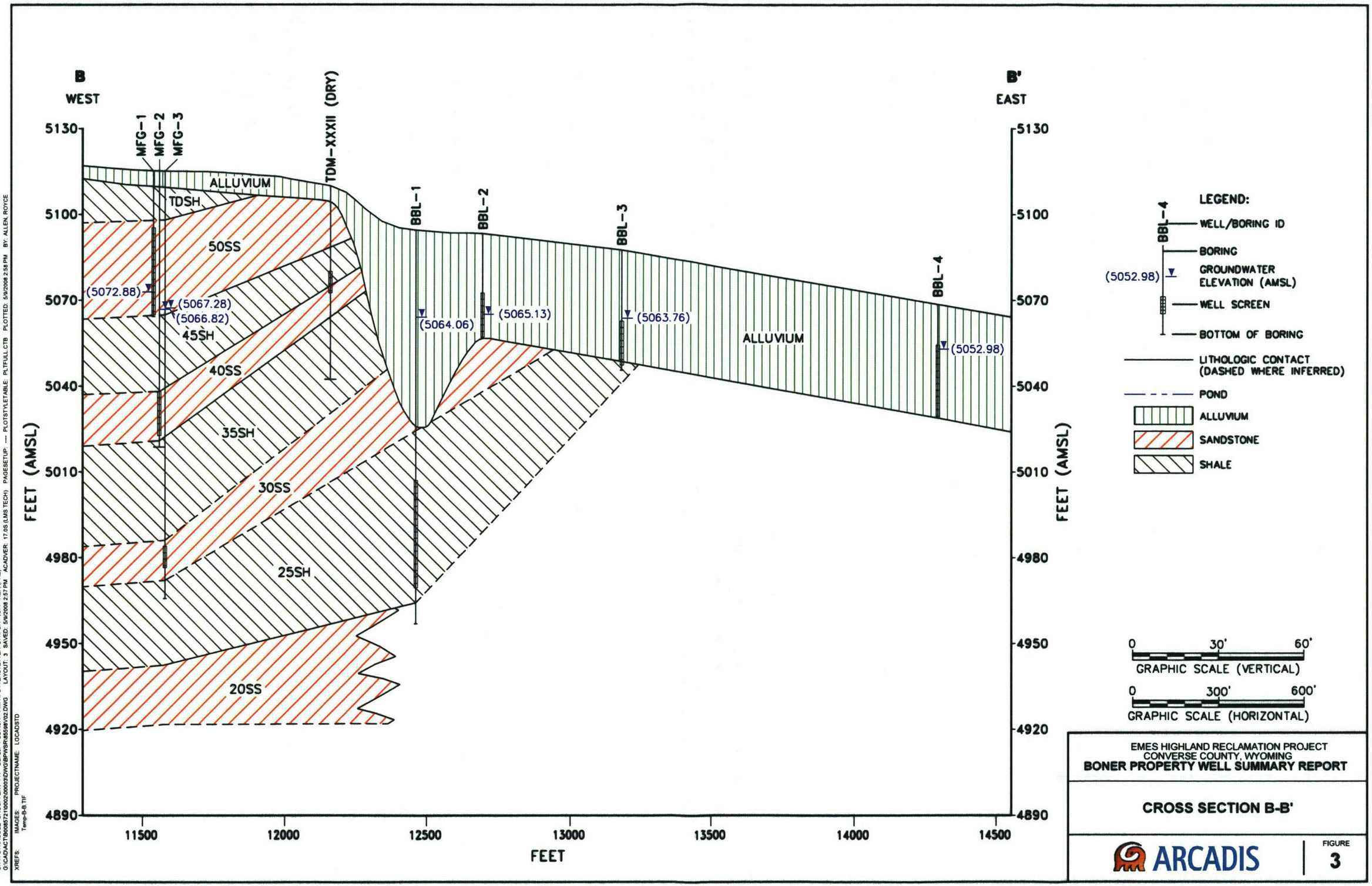
EMES HIGHLAND RECLAMATION PROJECT
CONVERSE COUNTY, WYOMING
BONER PROPERTY WELL SUMMARY REPORT

CROSS SECTION A-A'

ARCADIS

FIGURE
2

CITY: SYRACUSE GROUP: ENV-141 DB: LJP PGL: RCA PM: H. OTTERSTETTER LYR: ON=*;OFF=REF, (FR2)
G:\CADACT\90085721\002\0003\DWG\BPWSR\MS58WV01.DWG LAYOUT: 2 SAVED: 5/9/2008 2:54 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/9/2008 2:55 PM BY: ALLEN, ROYCE
XREFS: IMAGES: Temp-B-B.TIF PROJECTNAME: LGCADSTD



CITY: SYRACUSE GROUP: ENV-141 DB: LJP PGL RCA PM: H. OTTERSTETTER LYR: ON=*;OFF=REF, (FR2)
G:\CADACT\B0085721\00020000\DWG\BPWSR\85598V02.DWG LAYOUT: 3 SAVED: 5/9/2008 2:57 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/9/2008 2:58 PM BY: ALLEN, ROYCE
XREFS: IMAGES: PROJECTNAME: LGCADSTD
Temp-B-B.TIF

SYSTEM	SERIES	FORMATION	LITHOLOGY	DESCRIPTION
TERTIARY	EOCENE	WASATCH		Soil and Weathered Zone
				Discontinuous Sandstones and Shales Sandstone: grain size varies from medium-grained sand to gravel, most commonly medium to very coarse-grained sand; beds vary from loose friable sand to well-cemented (carbonate) sandstones. (Does not contain uranium mineralization.) Siltstone and Claystone (shale): color varies from olive orange to gray green but generally gray green; may contain thin interbedded sandstones and lignite beds.
	PALEOCENE	FORT UNION		TAILINGS DAM SANDSTONE: same as above (Does not contain uranium mineralization in Highland area)
				TAILINGS DAM SHALE: generally gray green with thin beds of sandstone
				UPPER ORE BODY SANDSTONE: same as above. (Ore bearing unit in Highland area.)
				Siltstone and Claystone (shale): generally gray green.
				MIDDLE ORE BODY SANDSTONE: same as above. (Major ore bearing unit in Highland area.)
				Siltstone and Claystone (shale): generally gray green; may contain thinbedded sandstone units.
				LOWER ORE BODY SANDSTONE: same as above. (Major ore bearing unit in Highland area.)
				Siltstone and Claystone (shale): generally gray green.
				Sandstone: same as above. (Does not contain economic amounts of uranium in Highland area.)
				Siltstone and Claystone (shale): same as above.

(From EPRCO, 1983)

SOURCE:
THIS DRAWING IS FROM THE FINAL DRAFT LONG-TERM PIT LAKE AND GROUNDWATER HYDROLOGY AT THE HIGHLAND MINE SITE, CONVERSE COUNTY, WYOMING BY MFG, INC., DATED FEBRUARY, 2006.

EMES HIGHLAND RECLAMATION PROJECT
CONVERSE COUNTY, WYOMING
BONER PROPERTY WELL SUMMARY REPORT

GENERALIZED STRATIGRAPHIC COLUMN, HIGHLAND AREA

ARCADIS

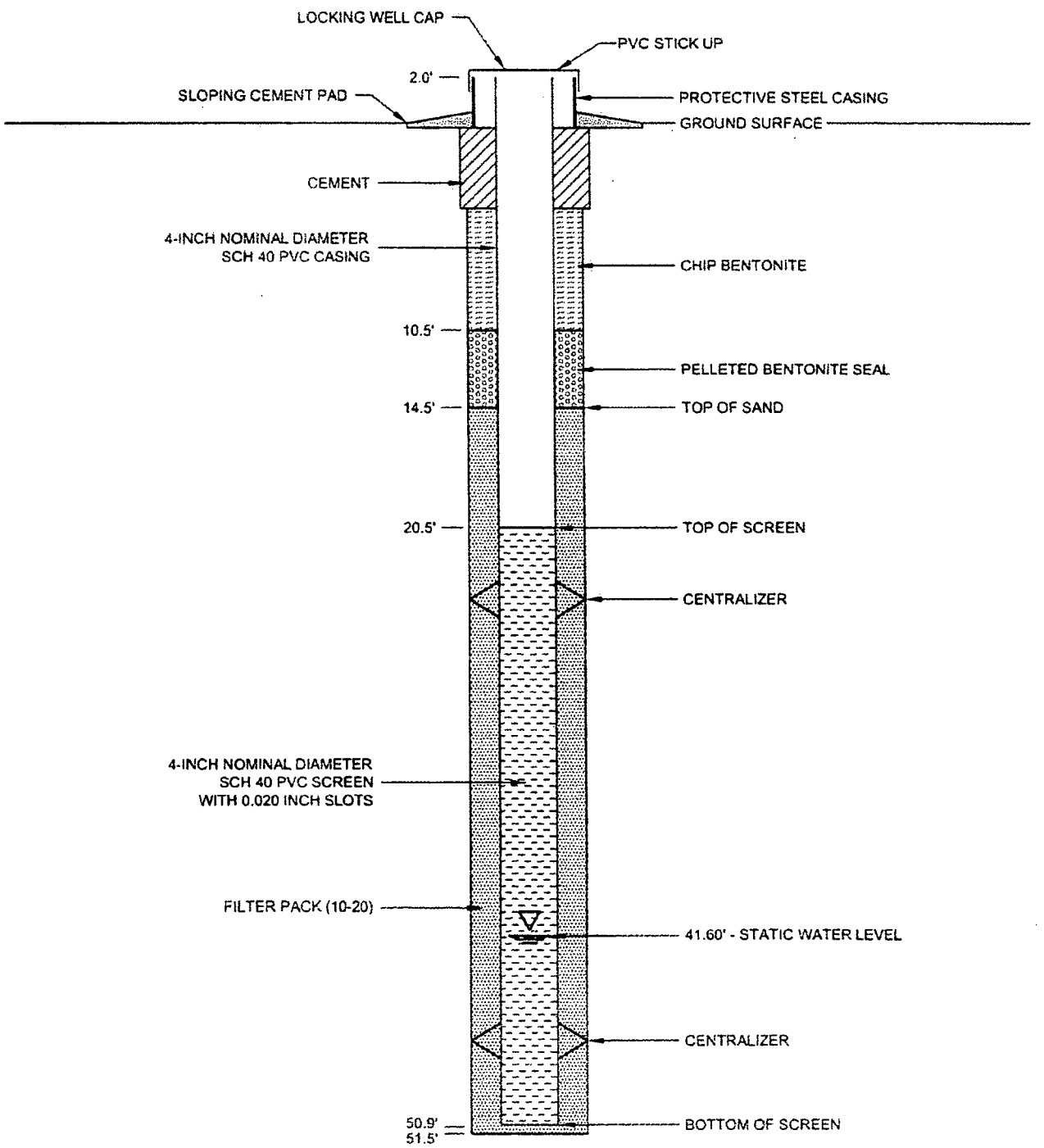
FIGURE
4

CITY:SYR DIV/GROUP:141 DB:JP KLS LD:LJ; PIC:(Opt) PM:LOTTERSTETTER TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\CADACT\B0085721\002\0003\EMES85721G01.DWG LAYOUT: 4 SAVED: 5/28/2008 7:35 AM ACADVER: 17.0S (LMS TECH) PAGESETUP: AP-PDF PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/28/2008 7:35 AM BY: SARTORI, KATHERINE
XREFS: IMAGES: PROJECTNAME: —
85721X02.TIF

ARCADIS

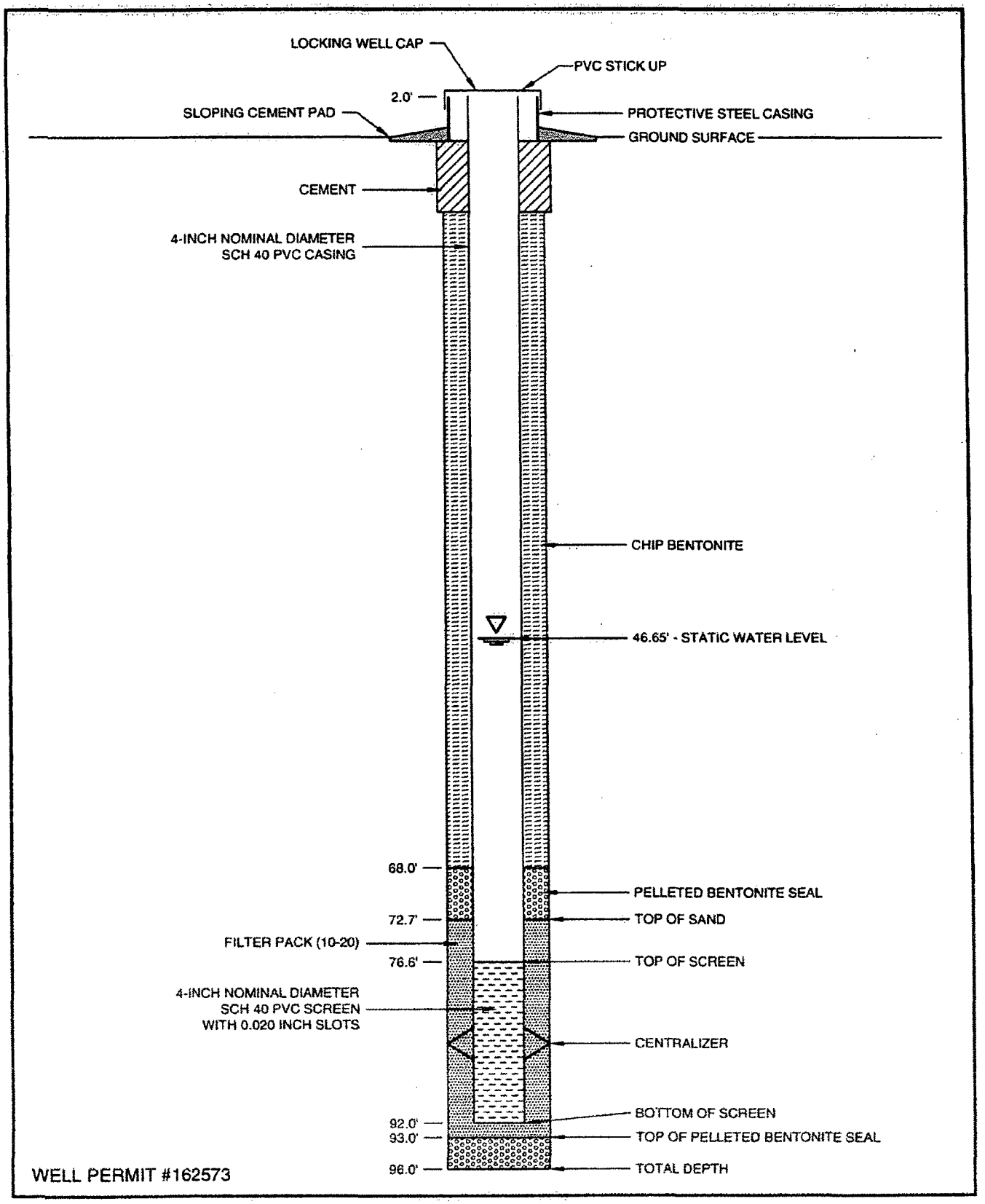
Appendix A

Monitoring Well Construction Diagrams

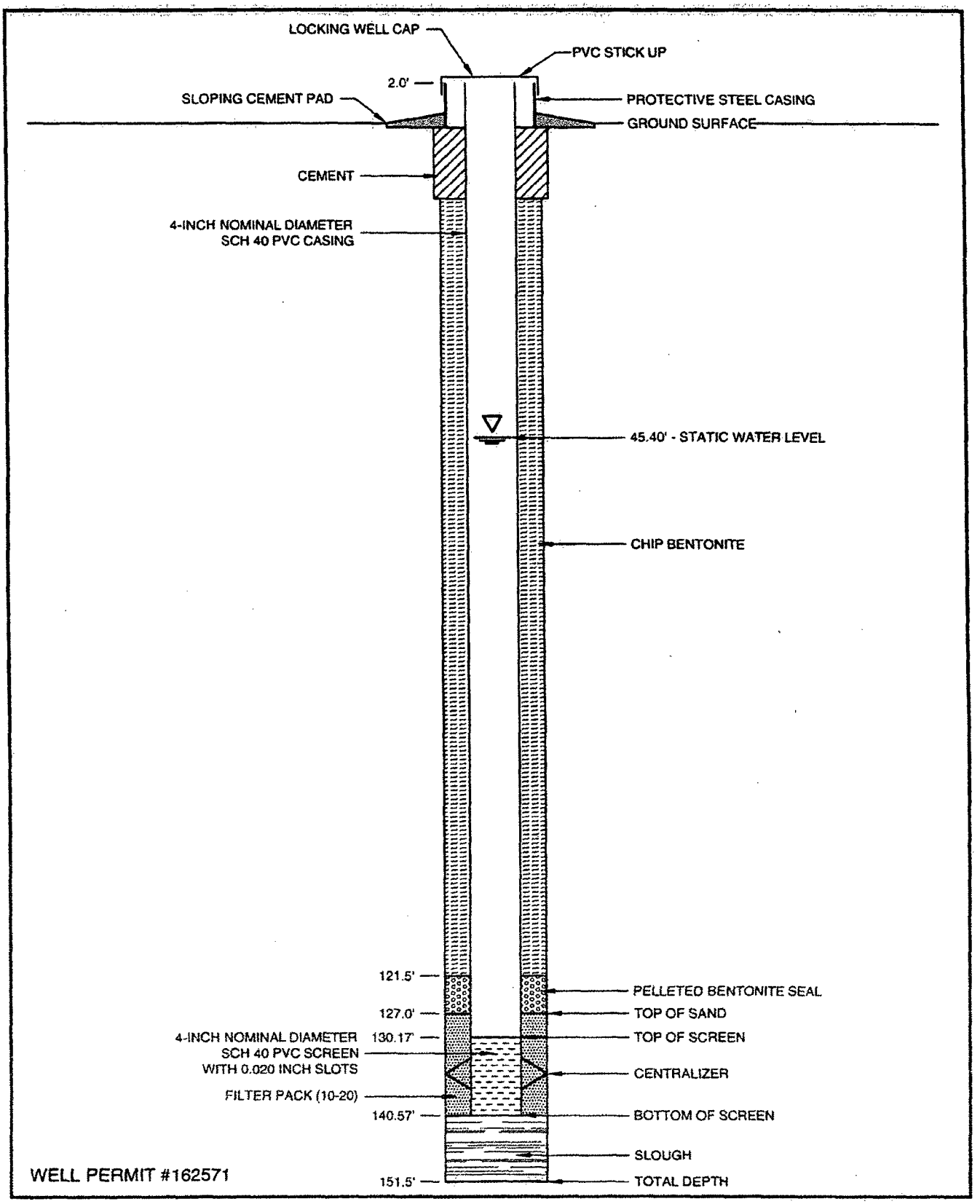


WELL PERMIT #162572

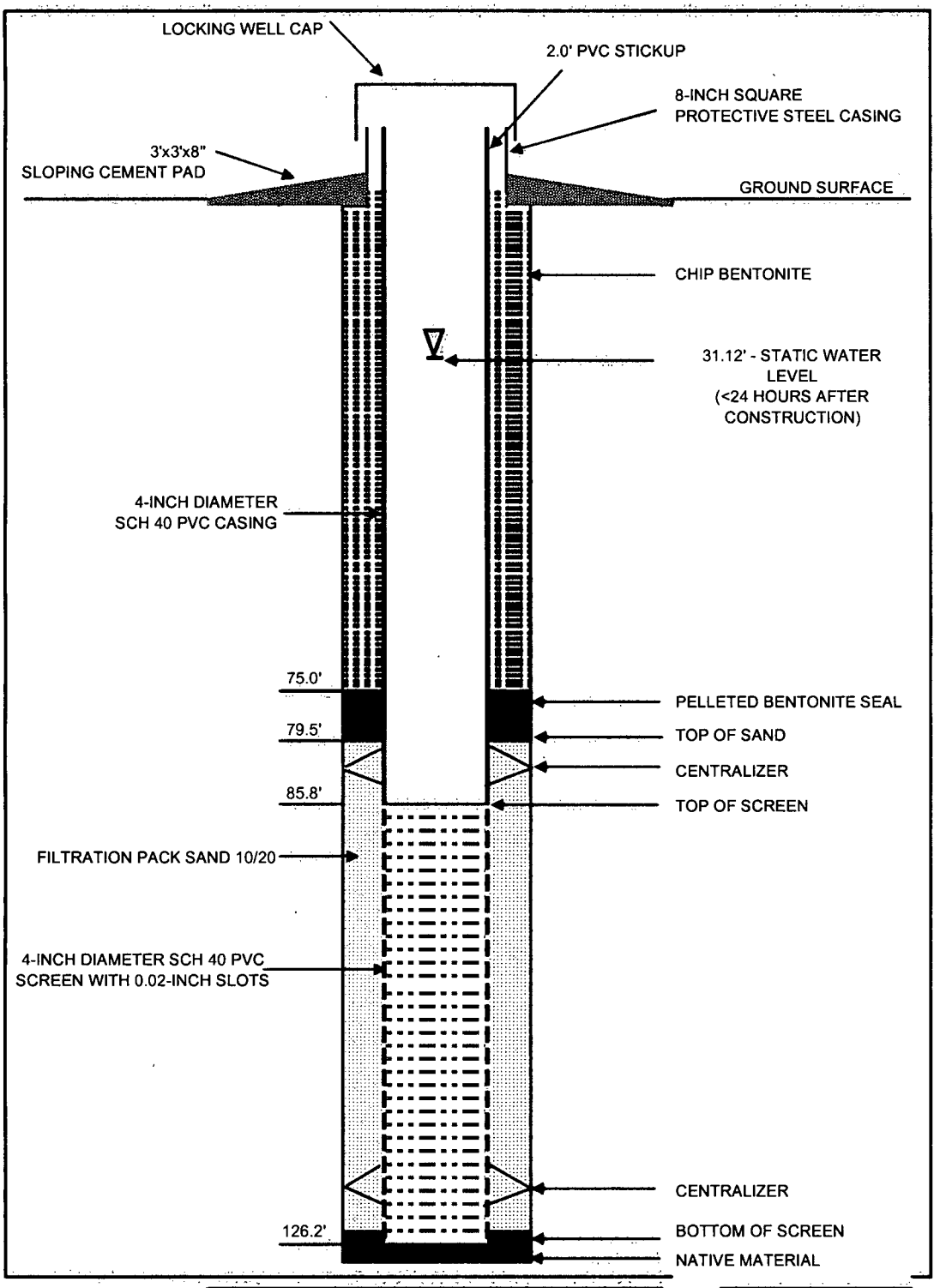
MFG, Inc. *consulting scientists and engineers*	FIGURE 5 WELL MFG-1 COMPLETION DETAIL	Date: NOVEMBER 2004 Project: 180548 File: WC-SUM.DWG



MFG, Inc. *consulting scientists and engineers*	FIGURE 6 WELL MFG-2 COMPLETION DETAIL	Date: NOVEMBER 2004 Project: 180548 File: WC-SUM.DWG



MFG, Inc. *consulting scientists and engineers*	FIGURE 7 WELL MFG-3 COMPLETION DETAIL	Date: NOVEMBER 2004 Project: 180548 File: WC-SUM.DWG

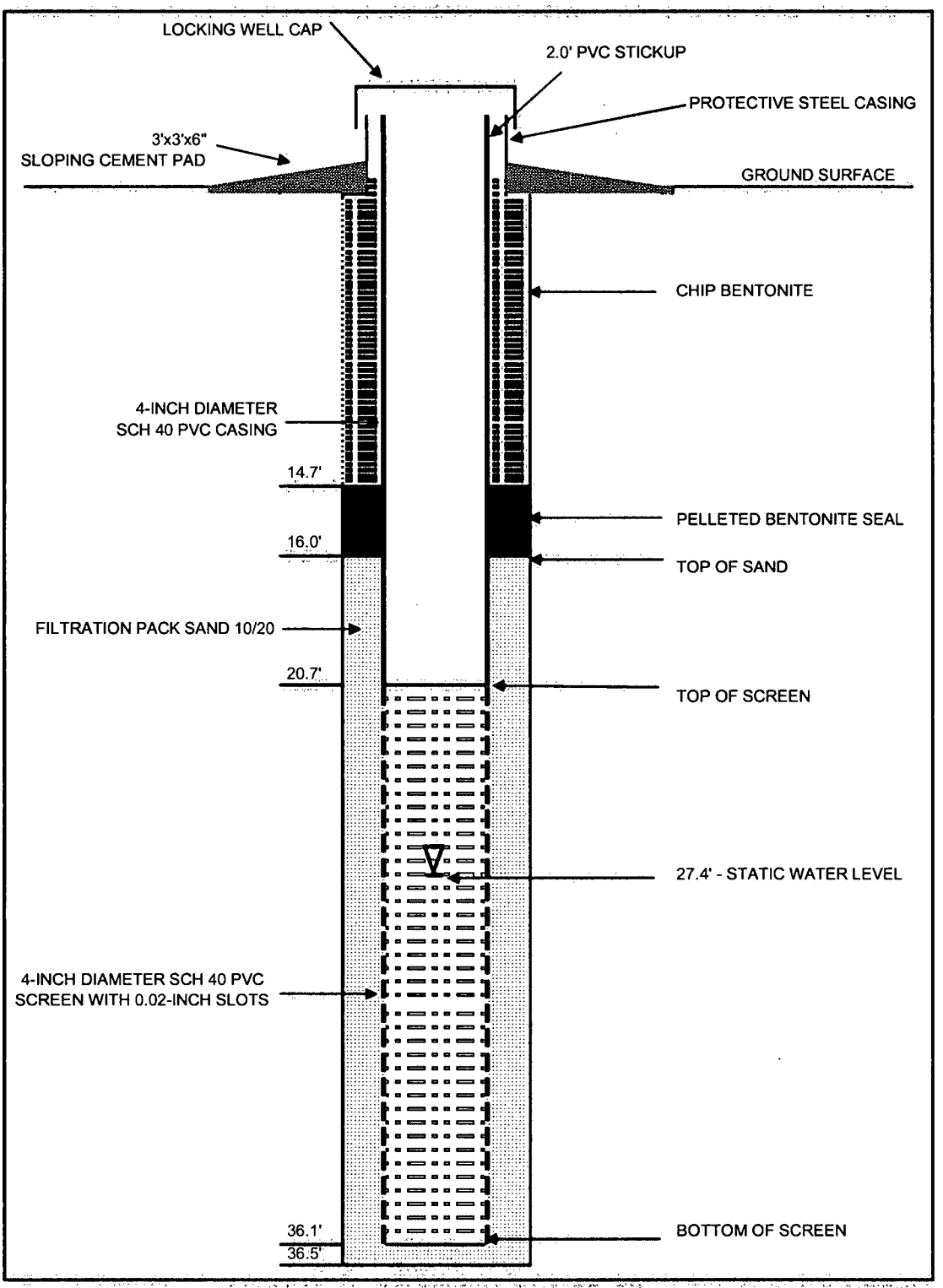


BBL an ARCADIS company

MONITORING WELL BBL - 1 COMPLETION DETAIL

DATE: AUGUST 2006
PROJECT: 85598
NOT TO SCALE

G:\PROJECTS\ExxonMobil\85598 Highland\Groundwater\MW Installation 2006\data\BBL-1 Well Completion Detail.xls



BBL an ARCADIS company

MONITORING WELL BBL - 2 COMPLETION DETAIL

DATE: AUGUST 2006
PROJECT: 85598
NOT TO SCALE

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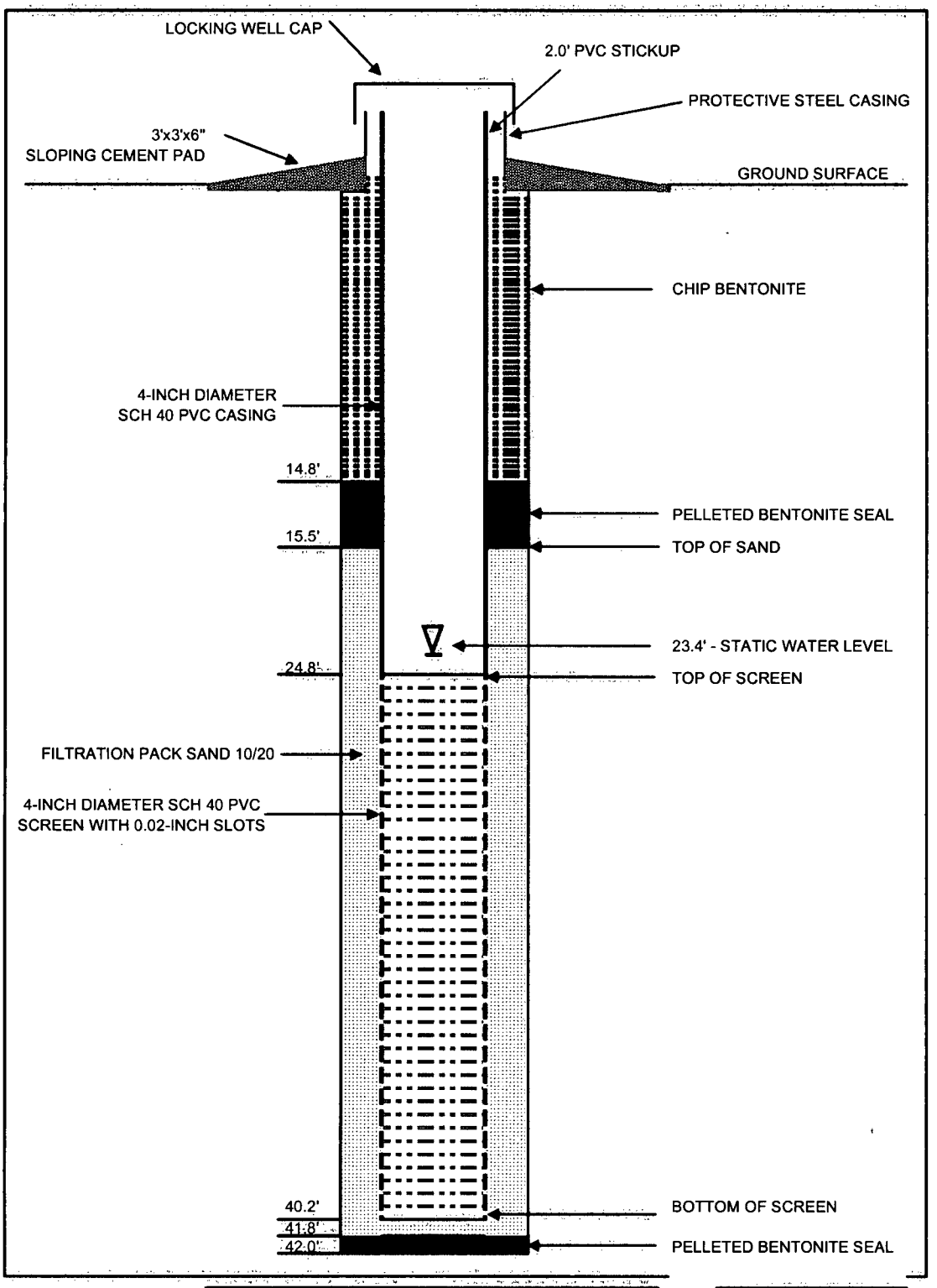
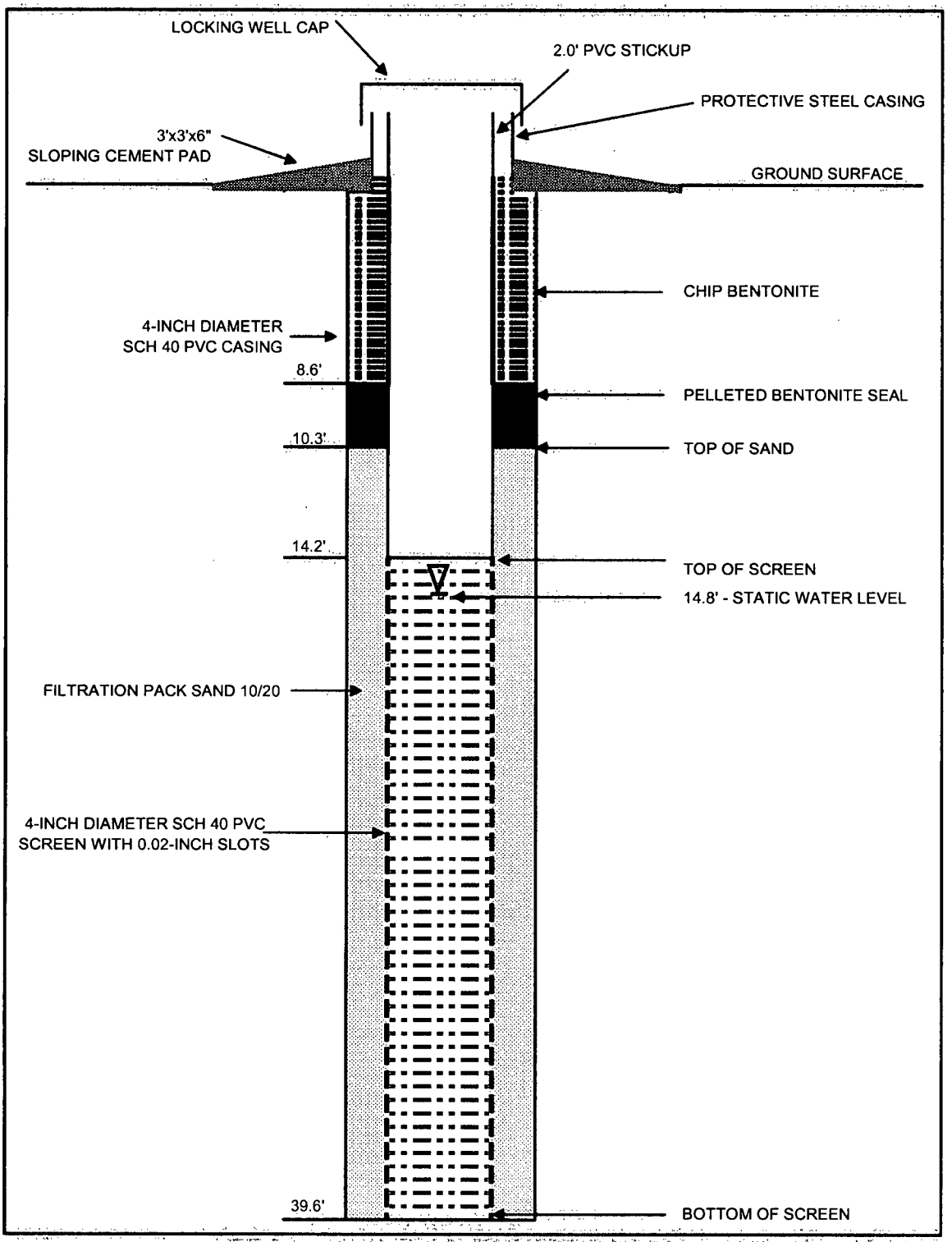


BBL an ARCADIS company

MONITORING WELL BBL - 3 COMPLETION DETAIL

DATE: AUGUST 2006
PROJECT: 85598
NOT TO SCALE

G:\PROJECTS\ExxonMobil\85598 Highland\Groundwater\MW Installation 2006\data\BBL-3 Well Completion Detail.xls



BBL® an ARCADIS company

MONITORING WELL BBL - 4 COMPLETION DETAIL

DATE: AUGUST 2006
PROJECT: 85598
NOT TO SCALE

G:\PROJECTS\ExxonMobil\85598 Highland\Groundwater\MW Installation 2006\data\BBL-4 Well Completion Detail.xls

ARCADIS

Appendix B

Monitoring Well Boring Logs

BORING LOG

MFG, Inc.
consulting scientists and engineers

BORING NO.
MFG-1

PROJECT: EXXONMOBIL HIGHLANDS PAGE: 1 of 1
PROJECT NO.: 180548 DATE: 10/6/04
NORTHING: 874029.528 EASTING: 414525.549 GROUND ELEVATION: 5115.827
DRILLING COMPANY: DRILLING ENGINEERS DRILLING METHOD: HSA/AIR ROTARY
DRILLER: ANDY LOZANO LOGGED BY: JOE REED

DEPTH (FT)	LITHOLOGY	DESCRIPTION/NOTES
0		0 - 3.5' TOPSOIL.
		3.5' - 13.0' Mixture of highly weathered shale, brown (10YR 5/3), and (~10%) weathered sandstone, fine grained, 10% silt, brown (10YR 5/3). At 10 ft. some silty clayey sand, brown (10YR 5/3), very slightly moist, fine sand.
10		
		13.0' - 15.0' Silty sandy, clay, brown (10YR 5/3), very slightly moist, occasional fine gravel, less sand than above.
		15.0' - 25.0' Silty sand, brownish yellow (10YR 6/6), fine sand, <10% silt, occasional medium sand, dry.
20		
		25.0' - 36.0' Fine sand, brown (10YR 5/3), <10% silt, dry.
30		
		36.0' - 38.0' Sand, brown (10YR 5/3), 50% fine sand, 30% medium sand, 20% coarse sand, angular to sub rounded, slightly moist, occasional shale.
		38.0' - 47.0' Fine sand, gray (10YR 5/1), <5% silt, wet.
40		
		47.0' - 51.0' Sand, brown (10YR 5/3), 40% fine sand, 40% medium sand, 20% coarse sand, wet.
50		
		51.0' - 51.5' Shale, gray (10YR 5/1), at 65 ft. some coal, wet.

FIGURE 2

100548\BH_MFG1-3.DWG

BORING LOG

MFG, Inc.
consulting scientists and engineers

BORING NO.
MFG-2

PROJECT: EXXONMOBIL HIGHLANDS PAGE: 1 of 1
PROJECT NO.: 180548 DATE: 10/7/04
NORTHING: 874038.331 EASTING: 414543.504 GROUND ELEVATION: 5114.744
DRILLING COMPANY: DRILLING ENGINEERS DRILLING METHOD: HSA/AIR ROTARY
DRILLER: ANDY LOZANO LOGGED BY: JOE REED

DEPTH (FT)	LITHOLOGY	DESCRIPTION/NOTES
0		0 - 3.5' TOPSOIL.
		3.5' - 13.0' Mixture of highly weathered shale, brown (10YR 5/3), and (~10%) weathered sandstone, fine grained, 10% silt, brown (10YR 5/3). At 10 ft. some silty clayey sand, brown (10YR 5/3), very slightly moist, fine sand.
		13.0' - 18.0' Silty sandy, clay, brown (10YR 5/3), very slightly moist, occasional fine gravel, less sand than above.
20		18.0' - 25.0' Silty sand, brownish yellow (10YR 6/6), fine sand, <10% silt, occasional medium sand, dry.
		25.0' - 38.0' Fine sand, brown (10YR 5/3), <10% silt, dry.
40		38.0' - 45.0' Fine sand, gray (10YR 5/1), <5% silt, wet.
		45.0' - 51.0' Sand, brown (10YR 5/3), 40% fine sand, 40% medium sand, 20% coarse sand, wet.
		51.0' - 73.0' Shale, gray (10YR 5/1), at 65 ft. some coal, wet.
60		
		73.0' - 92.0' Sands, gray (10YR 5/1), 30% fine sand, 40% medium sand, 30% coarse sand, rock at 82 ft.
80		
		92.0' - 96.0' Shale, gray (10YR 5/1).
100		

FIGURE 3

100548\BH_MFG1-3.DWG

BORING LOG

MFG, Inc.
consulting scientists and engineers

BORING NO.
MFG-3

PROJECT: EXXONMOBIL HIGHLANDS PAGE: 1 of 1
PROJECT NO.: 180548 DATE: 10/7/04
NORTHING: 874047.281 EASTING: 414561.693 GROUND ELEVATION: 5113.079
DRILLING COMPANY: DRILLING ENGINEERS DRILLING METHOD: HSA/AIR ROTARY
DRILLER: ANDY LOZANO LOGGED BY: JOE REED

DEPTH (FT)	LITHOLOGY	DESCRIPTION/NOTES
0		0 - 2.5' TOPSOIL.
		2.5' - 13.0' Mixture of highly weathered shale, brown (10YR 5/3), and (~10%) weathered sandstone, fine grained, 10% silt, brown (10YR 5/3). At 10 ft. some silty clayey sand, brown (10YR 5/3), very slightly moist, fine sand.
		13.0' - 15.0' Silty sandy, clay, brown (10YR 5/3), very slightly moist, occasional fine gravel, less sand than above.
		15.0' - 25.0' Silty sand, brownish yellow (10YR 6/6), fine sand, <10% silt, occasional medium sand, dry.
30		25.0' - 27.5' Hard cemented sandstone.
		27.5' - 36.0' Fine sand, brown (10YR 5/3), <10% silt, dry.
		36.0' - 38.0' Sand, brown (10YR 5/3), 50% fine sand, 30% medium sand, 20% coarse sand, angular to sub rounded, slightly moist, occasional shale.
		38.0' - 47.0' Fine sand, gray (10YR 5/1), <5% silt, wet.
		47.0' - 49.0' Sand, brown (10YR 5/3), 40% fine sand, 40% medium sand, 20% coarse sand, wet.
60		49.0' - 75.0' Shale, gray (10YR 5/1), at 65 ft. some coal, wet.
		75.0' - 92.0' Sands, gray (10YR 5/1), 30% fine sand, 40% medium sand, 30% coarse sand.
90		92.0' - 129.0' Shale, gray (10YR 5/1).
120		
		129.0' - 143.0' Sands, gray (10YR 5/1), 30% fine sand, 40% medium sand, 30% coarse sand, at 130 ft. interbedded sands and shales - mostly sand.
		143.0' - 151.5' Shale, gray (10YR 5/1).
150		

FIGURE 4

100548\BH_MFG1-3.DWG

BBL an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 06-29-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-1 P&A	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
					SILT (minor material: sand), trace clay, tan-brown, iron stains, loose, dry
			5		
					SILT (minor material: clay), brown, dense, moist
					CLAY (minor material: silt) weathered shale, brown, soft, moist
			10		
					Ca nodules
					moist
			15		
					Ca nodules, firm
					moist
			20		
			25		
					(minor material: fine sand, soft, wet)
			30		CLAY (minor material: sand), weathered shale, gray, iron stain, loose, producing water, air drilling
			35		
					SAND, coarse angular to poorly sorted, subrounded, heterogenous lithology

Completion Notes:

BBL-1 was initially drilled with hollow stem auger to 30 feet bgs and air rotary to 56.5 feet bgs. This borehole was adandoned due to caving sands. The abandoned BBL-1 borehole encountered an alluvial channel with a high conductivity alluvial sand deposit not encountered at other boreholes. This sand deposit was not encountered at the next BBL-1 location, which supports conclusion that it is an alluvial sand and not a bedrock sand deposit. Abandoned BBL-1 was sealed by filling with chip bentonite. BBL-1 was relocated 63 feet northwest of BBL-1 P&A.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL® an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 06-29-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-1 P&A	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
			45		Coarse-medium SAND (minor material: black shale, fragments of cemented sandstone, and quartz) multi-color: gray, brown, red, white, loose, mixture of large shale and sandstone fragments, alluvial gravel, subangular-subrounded
			50		Cemented fine SANDSTONE and black shale (mixed with shallow sands), believed to be bedrock, tan to black
					(minor material: fine black-gray cemented sandstone)
			55		(minor material: black shale)
			60		
			65		
			70		
			75		

Completion Notes:

BBL-1 was initially drilled with hollow stem auger to 30 feet bgs and air rotary to 56.5 feet bgs. This borehole was adandoned due to caving sands. The abandoned BBL-1 borehole encountered an alluvial channel with a high conductivity alluvial sand deposit not encountered at other boreholes. This sand deposit was not encountered at the next BBL-1 location, which supports conclusion that it is an alluvial sand and not a bedrock sand deposit. Abandoned BBL-1 was sealed by filling with chip bentonite. BBL-1 was relocated 63 feet northwest of BBL-1 P&A.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL® an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 7-6-06	Logged By:
Boring Dia: 8.25 Inches	Boring Number: BBL-1	Joe Reed, MFG Inc.

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
					SANDY CLAYEY SILT (minor material: very fine sandy clay), yellow-brown (10YR 5/4), slightly cohesive, loose, dry
			5		SANDY CLAYEY SILT (minor material: 10 % very fine sand and clay), brown (10 YR 5/3), slightly cohesive, loose to medium dense or soft to medium stiff, very slightly moist
			10		SILTY CLAY (minor material: silt), trace very fine sand, moist, trace white nodules (calcite), brown (10 YR 5/3), medium stiff
			15		
			20		
			25		
			30		SILTY CLAY (minor material: silt), trace very fine sand, dark gray brown (10YR 4/2), medium stiff, moist
			35		
					NO RETURN

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 85.8 to 126.2 feet bgs; schedule 40, solid, PVC casing from 0 to 85.8 feet bgs; backfilled with filter pack (10-20) sand from 79.5 to 125.9 feet bgs, hydrated 3/8" bentonite pellets from 75 to 79.5 feet bgs, and hydrated bentonite chips from 0 to 75 feet bgs . 3' X 3' X 8" concrete pad with 8" locking well vault installed at the surface. Static water level at 31.1 feet bgs.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL® an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 7-6-06	Logged By:
Boring Dia: 8.25 Inches	Boring Number: BBL-1	Joe Reed, MFG Inc.

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
			45, 50		Hard drilling. Believe to be top of bedrock.
			55, 60		SILTY CLAYEY SAND/SANDY CLAYEY SILT, (minor material: very fine sand, clay, silt), gray (5Y 5/1), slightly harder drilling, soft-medium dense, moist Trace medium sand
			65, 70, 75		Weathered SHALE/Weathered SHALE with coarse SAND/SANDY SHALE (minor material: 5-10% coarse sand, very fine sand), dark greenish gray (Gley 4/1), medium stiff to stiff, slightly moist, visual sample SHALE (minor material: trace fine sand), dark greenish gray (Gley 4/1), hard, dry, start air drilling shale
					SHALE (minor material: trace coal), black (10YR 2/1), hard - breaks easily with thumbnail, dry

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 85.8 to 126.2 feet bgs; schedule 40, solid, PVC casing from 0 to 85.8 feet bgs; backfilled with filter pack (10-20) sand from 79.5 to 125.9 feet bgs, hydrated 3/8" bentonite pellets from 75 to 79.5 feet bgs, and hydrated bentonite chips from 0 to 75 feet bgs . 3' X 3' X 8" concrete pad with 8" locking well vault installed at the surface. Static water level at 31.1 feet bgs.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 7-6-06	Logged By:
Boring Dia: 8.25 Inches	Boring Number: BBL-1	Joe Reed, MFG Inc.

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
			85		SHALE (minor material: trace very fine sand), dark gray (Gley 4) harder drilling, dry
					NO RETURN - Believed wet
			90		
					SHALE (minor material: trace very fine sand), dark gray (Gley 4), wet, intermittent returns
			95		Trace coal
					SHALE (minor material: trace very fine sand), dark gray (Gley 4/Black), producing more water <2 gpm
			100		Pyrite and Coal
			105		SHALE/SAND, interbedded shales and sands, mostly shale sand is fine, medium, and coarse, shale very dark gray (2.5Y 3/1), sand gray, approximately 2 gpm
					SHALE (minor material: trace coal, trace very fine sand) shale interbedded with sandy shale, very dark gray, (2.5Y 3/1), 2 gpm
			110		
			115		

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 85.8 to 126.2 feet bgs; schedule 40, solid, PVC casing from 0 to 85.8 feet bgs; backfilled with filter pack (10-20) sand from 79.5 to 125.9 feet bgs, hydrated 3/8" bentonite pellets from 75 to 79.5 feet bgs, and hydrated bentonite chips from 0 to 75 feet bgs . 3' X 3' X 8" concrete pad with 8" locking well vault installed at the surface. Static water level at 31.1 feet bgs.

Site:

Highland Mine

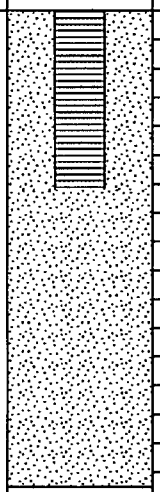
Converse County, WY

Project No.: 85598

BBL® an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 7-6-06	Logged By:
Boring Dia: 8.25 Inches	Boring Number: BBL-1	Joe Reed, MFG Inc.

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
			125 130 135 140 145 150 155		SHALE, no sandy shale layers, very dark gray (2.5Y 3/1), 2 gpm

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 85.8 to 126.2 feet bgs; schedule 40, solid, PVC casing from 0 to 85.8 feet bgs; backfilled with filter pack (10-20) sand from 79.5 to 125.9 feet bgs, hydrated 3/8" bentonite pellets from 75 to 79.5 feet bgs, and hydrated bentonite chips from 0 to 75 feet bgs . 3' X 3' X 8" concrete pad with 8" locking well vault installed at the surface. Static water level at 31.1 feet bgs.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 06-28-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-2	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
					SILT (minor material: sand), trace clay, tan-brown, dry
			5		SILTY CLAY (minor material: clayey silt), brown, soft, slightly moist
			10		tan-brown
			15		tan-brown gray
			20		
			25		tan
			30		SILT (minor material: sandy clay), moist
			35		very moist
	50				Cemented SANDSTONE, gray, dense, hard drilling dry/believed to be bedrock

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 20.7 to 36.1 feet bgs; schedule 40, solid, PVC casing from 0 to 20.7 feet bgs; backfilled with filter pack (10-20) sand from 16.0 to 36.5 feet bgs, hydrated 3/8" bentonite pellets from 14.7 to 16.0 feet bgs, and hydrated bentonite chips from 0 to 14.7 feet bgs. 3' X 3' X 6" concrete pad with 8" locking well vault installed at the surface.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

Page 1

BBL an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 06-28-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-3	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
					SILT (minor material: fine sand), tan-brown, loose, dry
			5		slightly moist Ca nodules, brown
			10		slightly clay, moist
			15		SILT and CLAY (minor material: clayey silt), slightly fine sand, firm
			20		SILT and CLAY (minor material: sand), brown-tan, soft
			25		SILT, Ca nodules
			30		SILTY CLAY (minor material: fine sand with trace shale fragments), soft, moist, wet at 35'
			35		SILTY CLAY (minor material: <10% fine sand) trace shale fragment, soft, wet

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 24.8 to 40.2 feet bgs; schedule 40, solid, PVC casing from 0 to 24.8 feet bgs; backfilled with hydrated 3/8" bentonite pellets from 41.8 to 42.0 feet bgs, filter pack (10-20) sand from 15.5 to 41.8 feet bgs, hydrated 3/8" bentonite pellets from 14.8 to 15.5 feet bgs, and hydrated bentonite chips from 0 to 14.8 feet bgs. 3' X 3' X 6" concrete pad with 8" locking well vault installed at the surface.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 06-28-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-3	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
					SHALE, black, hard, believed to be bedrock
			45		SAND (minor material: shale), visible sample was gray sand with large, black shale fragments (thumb wide)
			50		
			55		
			60		
			65		
			70		
			75		

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 24.8 to 40.2 feet bgs; schedule 40, solid, PVC casing from 0 to 24.8 feet bgs; backfilled with hydrated 3/8" bentonite pellets from 41.8 to 42.0 feet bgs, filter pack (10-20) sand from 15.5 to 41.8 feet bgs, hydrated 3/8" bentonite pellets from 14.8 to 15.5 feet bgs, and hydrated bentonite chips from 0 to 14.8 feet bgs. 3' X 3' X 6" concrete pad with 8" locking well vault installed at the surface.

Site:

Highland Mine

Converse County, WY

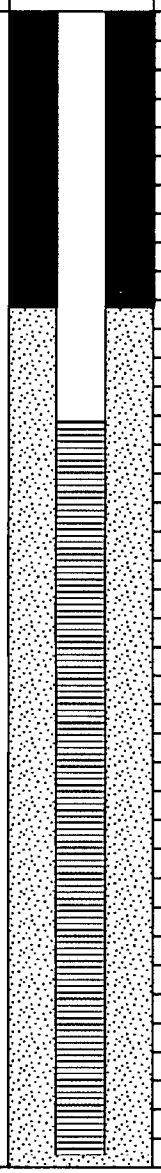
Project No.: 85598

BBL an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 07-01-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-4	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
					SILT (minor material: sand), tan-brown, loose, dry
			5		CLAY (minor material: silt) some fine sand, some medium sand, brown, soft, slightly moist
			10		CLAY (minor material: sand), >20% fine sand, moist, wet at 14'
			15		20-30% fine sand
			20		5-10% medium sand, 20-30% fine sand
			25		10% sand, increasing clay
			30		trace sand
			35		trace gravel and sand



Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 14.2 to 39.6 feet bgs; schedule 40, solid, PVC casing from 0 to 14.2 feet bgs; backfilled with filter pack (10-20) sand from 10.3 to 39.6 feet bgs, hydrated 3/8" bentonite pellets from 8.6 to 10.3 feet bgs, and hydrated bentonite chips from 0 to 8.6 feet bgs. 3' X 3' X 6"concrete pad with 8" locking well vault installed at the surface.

Site:

Highland Mine

Converse County, WY

Project No.: 85598

BBL® an ARCADIS company

BORING LOG

Driller: Drilling Engineers, Inc.	Date Drilled: 07-01-06	Logged By:
Boring Dia: 6.25 Inches	Boring Number: BBL-4	Reed Lyday

Sample	Blow Counts	Completion	Depth Feet	Lithology	Description
	14/24				SILT (minor material: slightly sand), gray, dense, dry; visible sample taken by split-spoon
			45		
			50		
			55		
			60		
			65		
			70		
			75		

Completion Notes:

Schedule 40, 0.020" slotted PVC casing from 14.2 to 39.6 feet bgs; schedule 40, solid, PVC casing from 0 to 14.2 feet bgs; backfilled with filter pack (10-20) sand from 10.3 to 39.6 feet bgs, hydrated 3/8" bentonite pellets from 8.6 to 10.3 feet bgs, and hydrated bentonite chips from 0 to 8.6 feet bgs. 3' X 3' X 6"concrete pad with 8" locking well vault installed at the surface.

Site:

Highland Mine

Converse County, WY

Project No.: 85598