

**3M PROJECT
La Plata County, Colorado**

**Monitoring Well Installation Report
and
Operations Manual**



Prepared for

Colorado Oil and Gas Conservation Commission
Denver, Colorado

Prepared by

Applied Hydrology Associates, Inc.
Denver, Colorado

October 2002

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C-6 Motorola Cellular Telephone Modem Quick Reference Card
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1.0 INTRODUCTION

1.1 Scope

The BLM San Juan Field Office (BLM), the Southern Ute Indian Tribe (SUIT), and the Colorado Oil and Gas Conservation Commission (COGCC) are jointly undertaking a comprehensive study of the Fruitland Formation in the San Juan Basin, southwestern Colorado. This study is called the “3M Project”, which refers to its three main components: geologic mapping, groundwater monitoring, and computer modeling.

The groundwater-monitoring component of the 3M Project has involved the installation and monitoring of groundwater and gas pressure monitor wells at various locations along the northern margin of the San Juan Basin. Applied Hydrology Associates, Inc. (AHA) of Denver, Colorado was engaged by COGCC to perform the following related Tasks:

Task	Description
1	Perform lithologic logging, and oversee and document drilling, well completion, and geophysical logging of the wells.
2	Design, build, and install sealed wellheads.
3	Install, calibrate, and test pressure transducers and related monitoring and telemetry equipment.
4	Download pressure data monthly and prepare monthly monitoring reports (ongoing).
5	Prepare a manual describing operation of the monitoring equipment and procedures for downloading data and that contains manufacturer supplied “owner’s manuals” for all equipment.

This report documents Tasks 1 through 3 and completes Task 5. It describes the as-built construction of the 3M Project monitoring well systems, including well drilling and completion, wellhead installations, and pressure logging and telemetry system installation and operation.

Drilling, well completion, geophysical logging, and monitoring/telemetry equipment installation activities were started in January 2001 and completed in May 2002

Monthly monitoring data downloads and reporting activities (Task 4) are ongoing. Data reports are submitted to the COGCC under separate cover.

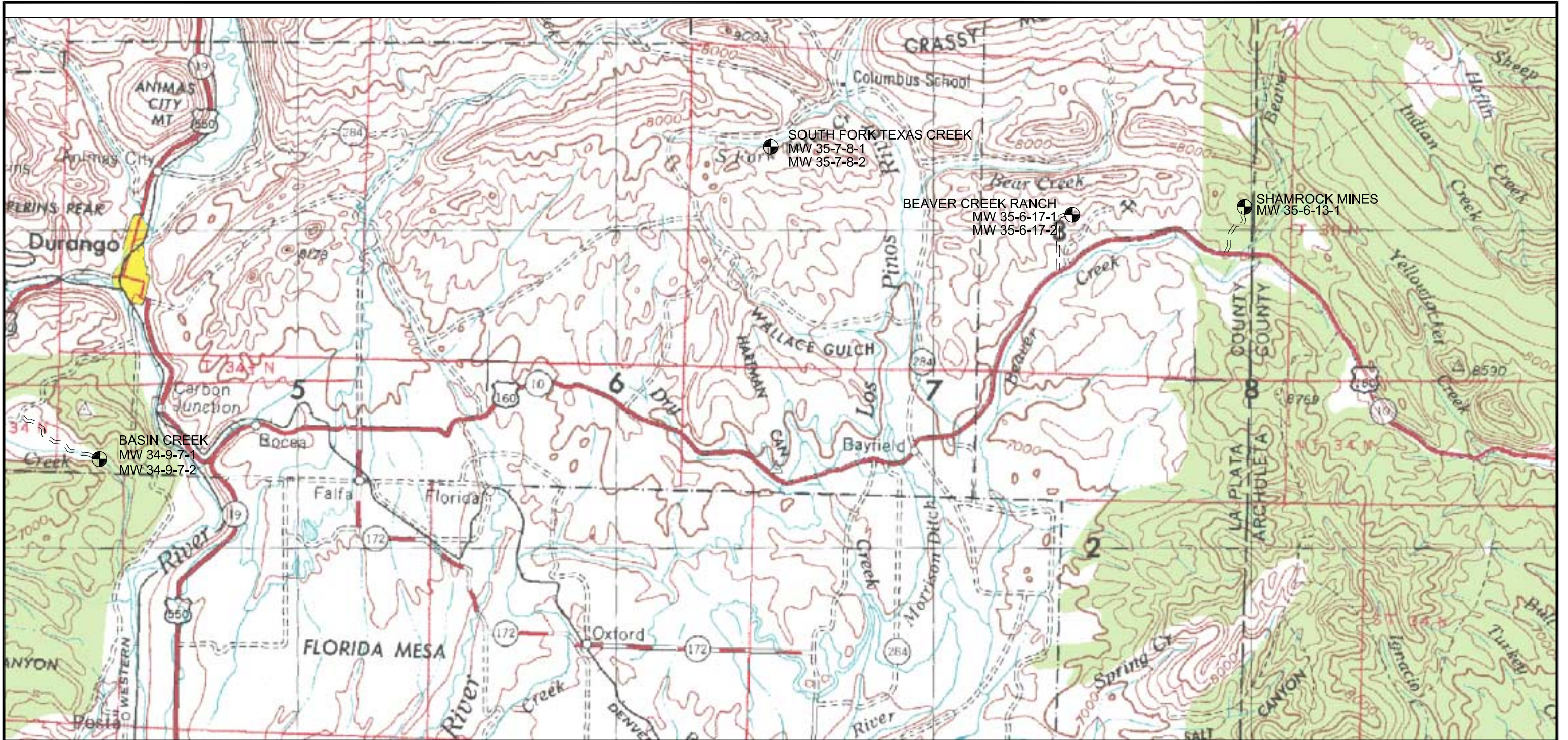
1.2 Well Sites and Designations

Seven monitoring wells have been installed at four sites in La Plata County: Basin Creek, South Fork Texas Creek, Beaver Creek Ranch, and Shamrock Mines (Figures 1-1 through 1-5). Well designations, location descriptions, elevations, and coordinates are listed in Table 1-1. Monitoring well (MW) designations include both well location by Section, Township, and Range, and well number (either 1 or 2). For example, well MW 35-6-17-1 is located in

Township 35, Range 6, Section 17, and is well number “1” at this location. The well numbering scheme is the same for all locations. Thus, the designation for the deepest well ends with the number “1”, and the shallower well designation ends with the number “2”.

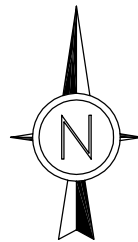
**Table 1-1
Monitoring Well Locations, Elevations, and Coordinates**

Location	Well ID	N Ute Line Description				Top of Pad Elevation		Coordinates UTM (Meters)		Latitude (Degrees)	Longitude (Degrees)
		QQ	Sec	T	R	Feet	Meters	Northing	Easting		
Basin Creek	MW 34-9-7-1	NESE	7	34N	9W	6679.61	2035.94	4122811.13	243837.80	37.21848	107.88688
	MW 34-9-7-2					6682.32	2036.77	4122817.80	243843.60	37.21854	107.88682
South Fork Texas Creek	MW 35-7-8-1	NESE	8	35N	7W	7504.75	2287.45	4132635.41	264914.46	37.31249	107.65270
	MW 35-7-8-2					7505.14	2287.57	4132629.25	264914.04	37.31244	107.65270
Beaver Creek Ranch	MW 35-6-17-1	SESE	17	35N	6W	7378.28	2248.90	4130475.98	274373.72	37.29539	107.54540
	MW 35-6-17-2					7381.45	2249.87	4130487.63	274383.67	37.29550	107.54529
Shamrock Mines	MW 35-6-13-1	NWSW	13	35N	6W	7717.12	2352.18	4130738.94	279795.72	37.29906	107.48436
<p align="center">Notes: Horizontal Datum - NAD 27 UTM Zone 13 (Converted from NAD 83 (1992) by NADCON) Vertical Datum - NAVD 88 Geoid 99 Elevations are to top of concrete pad north side of wellhead</p>											



 MONITORING WELL SITE AND DESIGNATION

SOURCE
USGS 1° X 2° SERIES (TOPOGRAPHIC)
NJ 13-7
DURANGO, COLORADO



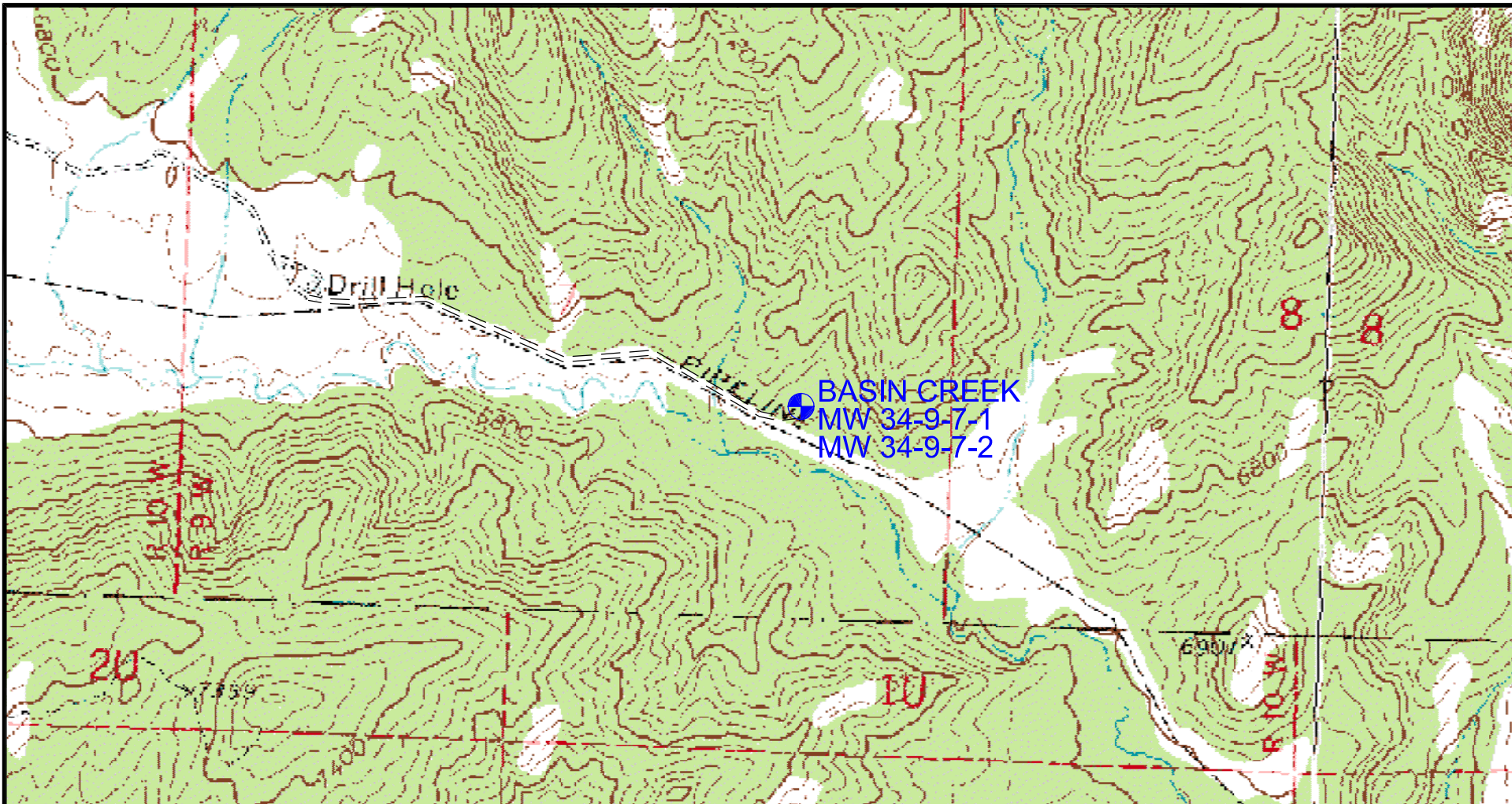
0 10,000 20,000
FEET
CONTOUR INTERVAL 200 FEET

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La Plata County, CO

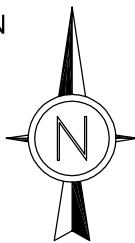
FIGURE 1-1
3M SITE MAP
WELL LOCATIONS

DESIGN: NLH	DATE: 6/12/02	DRAWING NUMBER
DRAWN: JLS	SCALE: AS SHOWN	San Juan Dur-Bay.dwg
SCRIPT:		



 MONITORING WELL SITE AND DESIGNATION

SOURCE
 USGS 7.5' SERIES (TOPOGRAPHIC)
 BASIN MOUNTAIN QUADRANGLE
 COLORADO - LA PLATA COUNTY

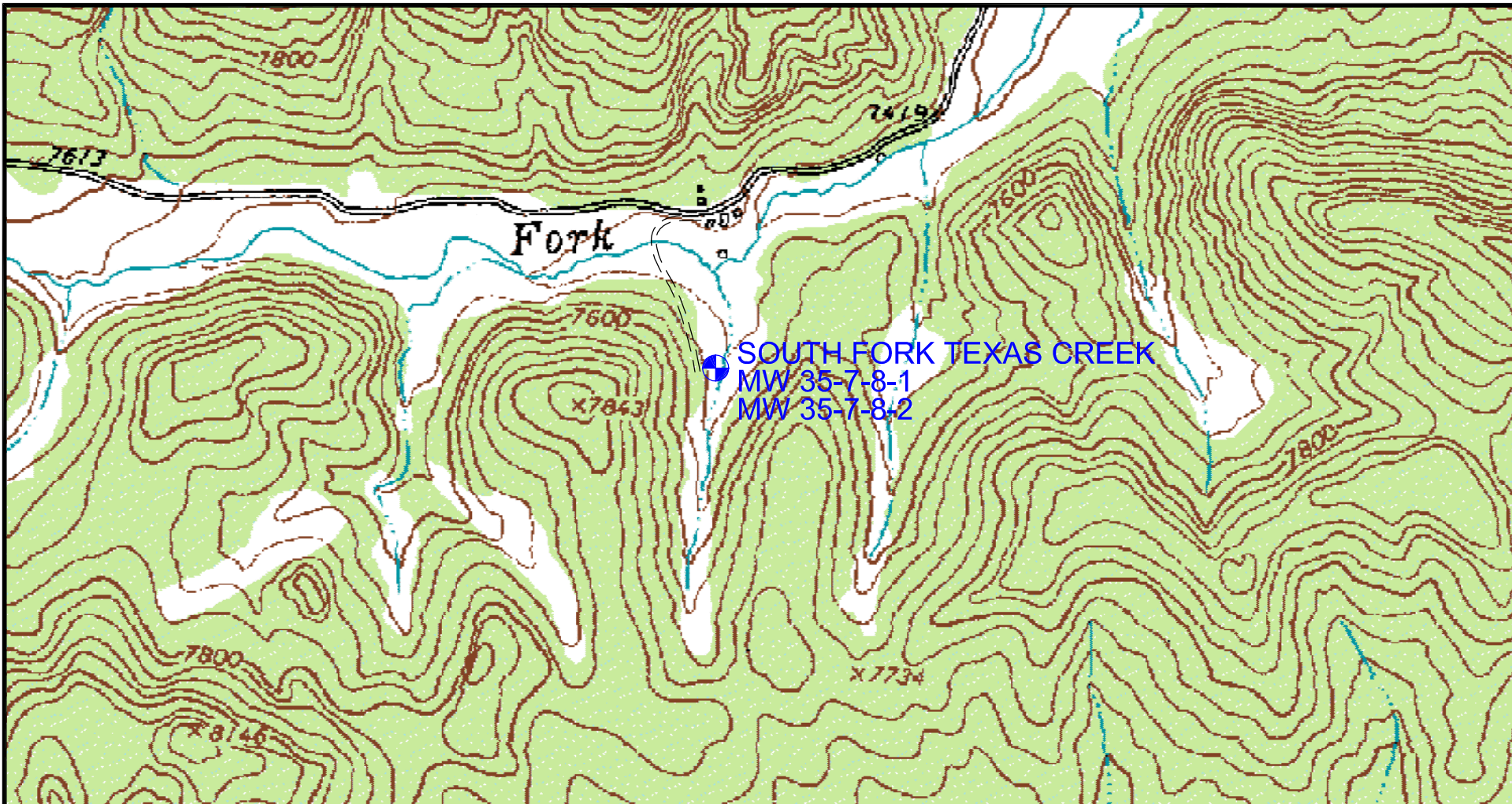



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FIGURE 1-2
3M SITE
BASIN CREEK
MW 34-9-7-1
MW 34-9-7-2

DESIGN: NLH	DATE: 6/12/02	DRAWING NUMBER
DRAWN: JLS	SCALE: AS SHOWN	San Juan Dur-Bay.dwg
SCRIPT:		



 MONITORING WELL SITE AND DESIGNATION

SOURCE
 USGS 7.5' SERIES (TOPOGRAPHIC)
 RULES HILL QUADRANGLE
 COLORADO - LA PLATA COUNTY

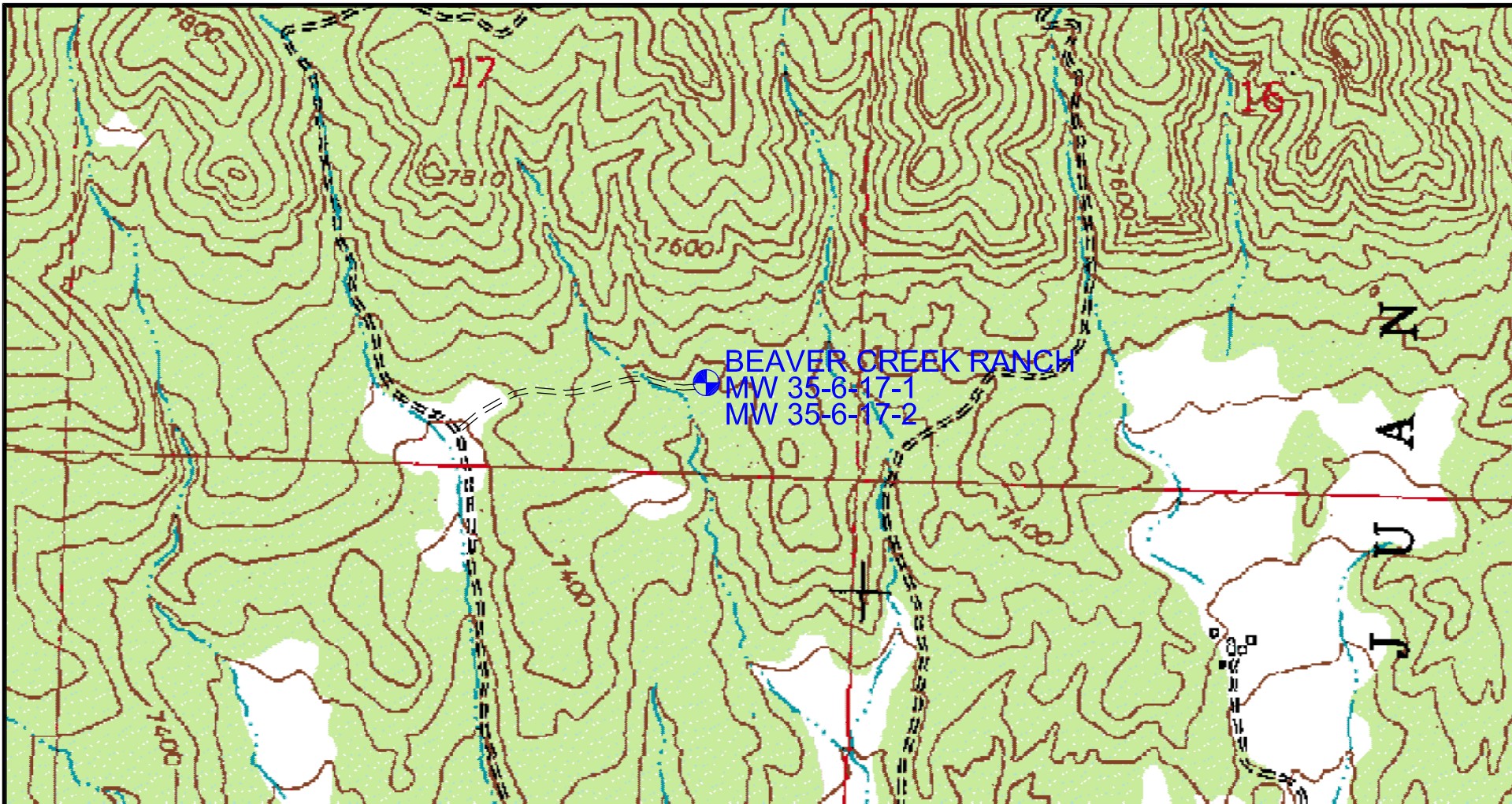


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FIGURE 1-3
3M SITE
SOUTH FORK TEXAS CREEK
MW 35-7-8-1
MW 35-7-8-2

DESIGN: NLH	DATE: 6/12/02	DRAWING NUMBER
DRAWN: JLS	SCALE: AS SHOWN	San Juan Dur-Bay.dwg
SCRIPT:		



 MONITORING WELL SITE AND DESIGNATION

SOURCE
 USGS 7.5' SERIES (TOPOGRAPHIC)
 LUDWIG MOUNTAIN QUADRANGLE
 COLORADO - LA PLATA COUNTY

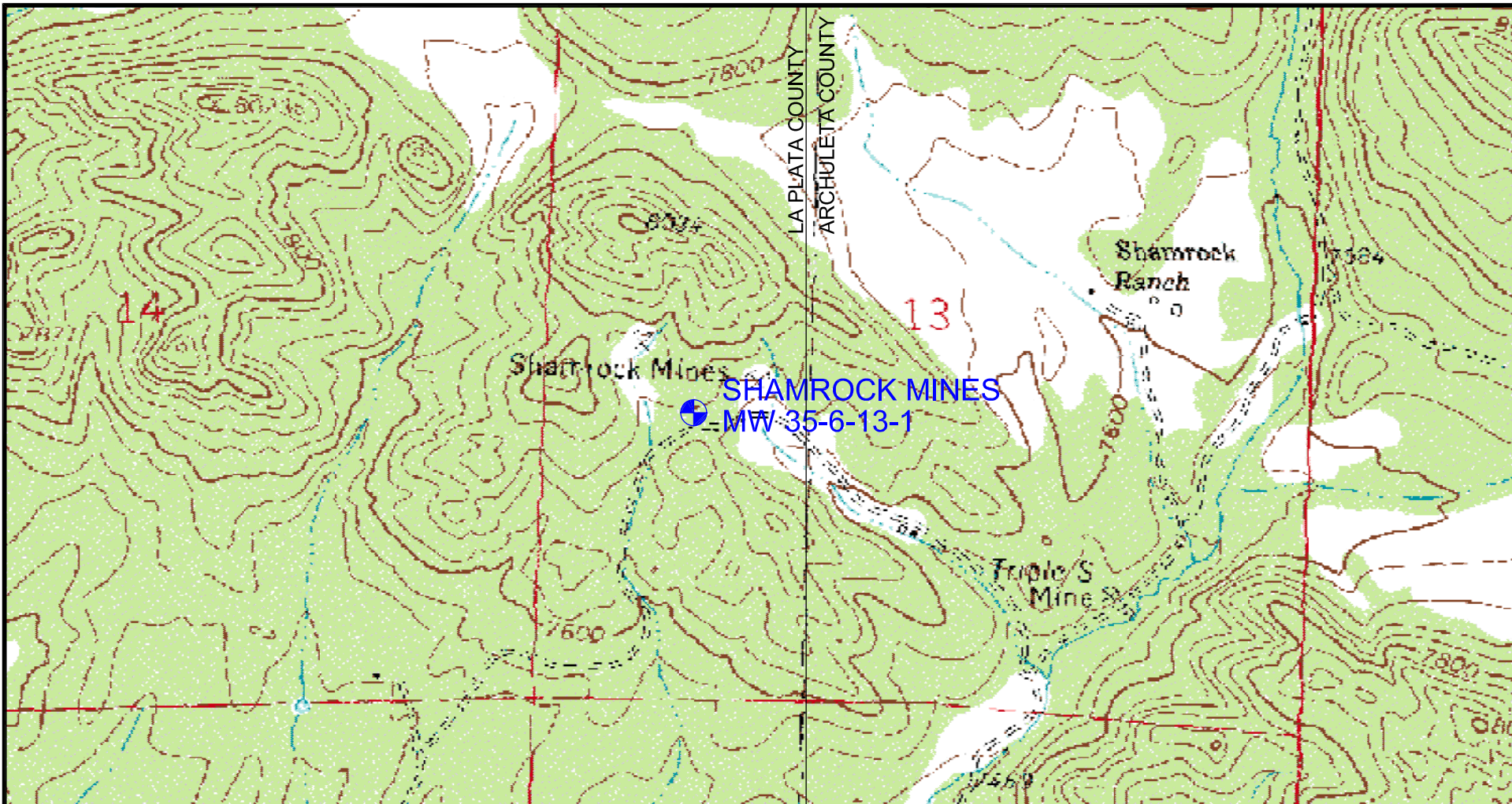


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FIGURE 1-4
 3M SITE
 BEAVER CREEK RANCH
 MW 35-6-17-1
 MW 35-6-17-2

DESIGN:	NLH	DATE:	6/12/02	DRAWING NUMBER
DRAWN:	JLS	SCALE:	AS SHOWN	San Juan Dur-Bay.dwg
SCRIPT:				



 MONITORING WELL SITE AND DESIGNATION

SOURCE
 USGS 7.5' SERIES (TOPOGRAPHIC)
 BALDY MOUNTAIN QUADRANGLE
 COLORADO - LA PLATA COUNTY



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FIGURE 1-5
3M SITE
SHAMROCK MINES
MW 35-6-13-1

DESIGN: NLH	DATE: 6/12/02	DRAWING NUMBER
DRAWN: JLS	SCALE: AS SHOWN	San Juan Dur-Bay.dwg
SCRIPT:		

2.0 MONITORING WELL SYSTEM DESIGN AND CONSTRUCTION

2.1 Design Criteria

The seven completed wells and corresponding monitoring systems were designed and installed to meet specific criteria requested by the COGCC:

- 1) Drill and complete monitoring wells in coal seams encountered in the Fruitland Formation.
- 2) Equip wells with two pressure transducers: one to measure the shut-in pressure immediately above the perforated interval(s) and the other to measure shut-in pressure near ground surface.
- 3) Provide sealed wellheads fitted with appropriate gas shut-in/venting and gas sampling valve systems, pressure gauge, and pressure transducer cable ports.
- 4) Select a versatile, self-contained, and rugged field data logger system for operation of remote site, automated well pressure data collection and transfer.
- 5) Provide telemetry systems for remote control of data collection and transfer of information between data loggers and office PCs.

2.2 Monitoring Wells

Monitoring well construction and completion details for each location are summarized in Table 2-1. Monitoring well completion reports are included in Appendix A.

2.3 Wellheads

Wellhead configurations and applicable hardware were finalized in the field depending on actual gas pressures encountered in the targeted coal intervals.

Low Gas Pressure Wellheads. Wellhead assemblies for the following wells consist of galvanized steel fittings with a standard pressure rating of 150 psi (Figures 2-1 and 2-2, and Photos 1 and 2 in Appendix B):

- Basin Creek: MW 34-9-7-1 and MW 34-9-7-2
- South Fork Texas Creek: MW 35-7-8-1 and MW 35-7-8-2
- Shamrock Mines: MW 34-6-13-1

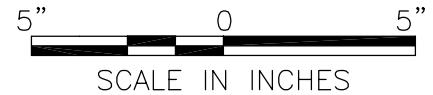
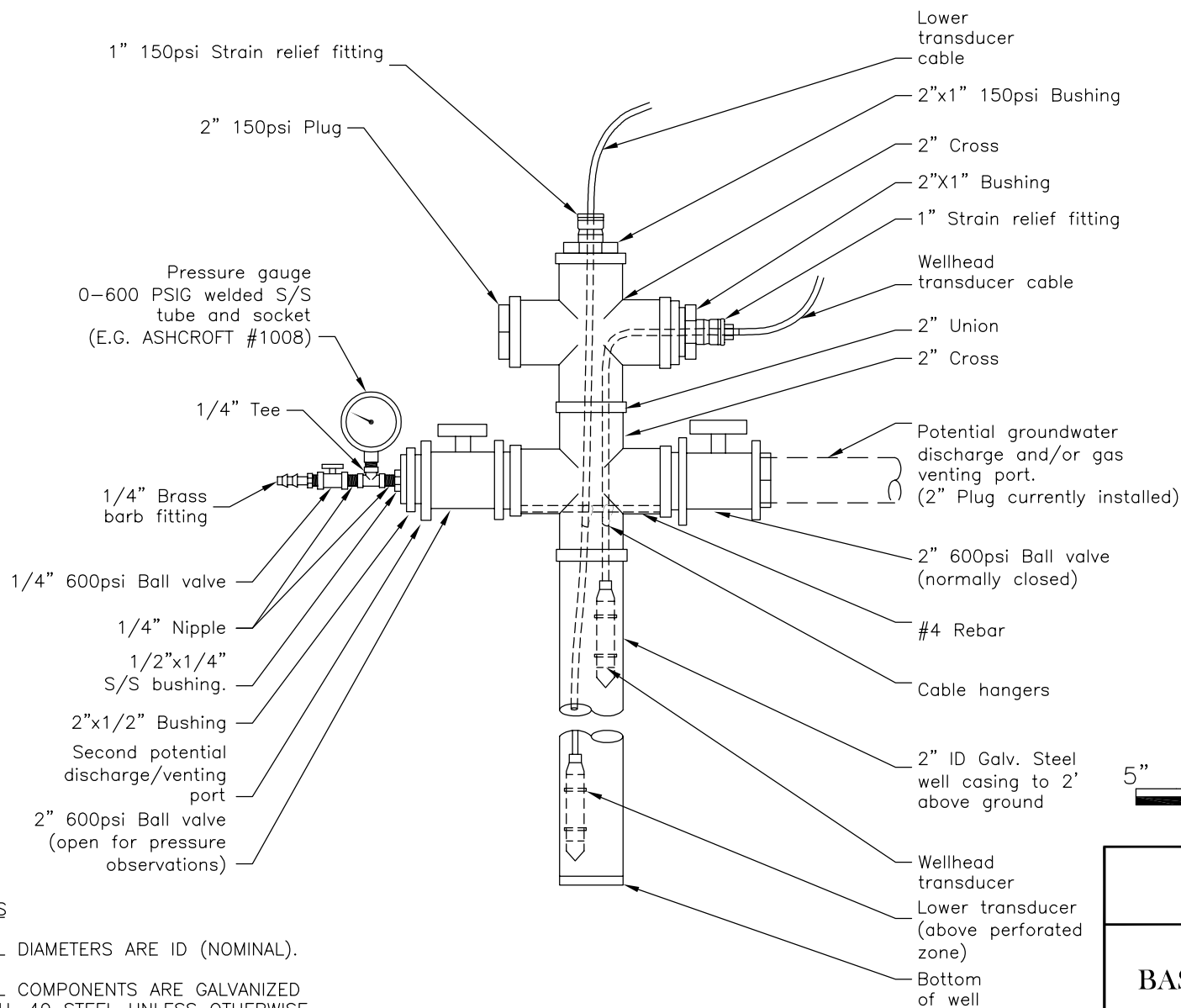
The wellhead assembly, shown in Figure 2-1, includes a top cross with spare port that can be used, as needed, for installation of an optional bubbler-line pressure monitoring system. Figure 2-2 shows a field-modified version of this wellhead assembly. This modification simplified both wellhead assembly construction and transducer installation/removal by eliminating a cross, a union and two nipples.

High Gas Pressure Wellheads. Beaver Creek Ranch well MW 35-6-17-2 has a shut-in gas pressure of over 600 psi, which requires the use of heavy-duty steel wellhead fittings with a minimum pressure rating of 1,000 psi (Figure 2-3 and Photo 3 in Appendix B).

As a precaution, high pressure wellhead fittings have also been used for Beaver Creek Ranch well MW 35-6-17-1 (Figure 2-4). However, the measured shut-in gas pressure for this well since completion is only about 15 psi.

**Table 2-1
Monitoring Well Completion Summary**

Location	Well ID	Construction Completion Date	Drilled Depth (fbgs)	Cored Intervals (fbgs)	Casing Depth (fbgs)	Casing Stickup (ft)	Well Casing Material	Perforated Interval(s) - Coal seam(s) (fbgs)	Wellhead Design (Figure Number)	Log Type	Logged Depth (fbgs)	Log Date
Basin Creek	MW 34-9-7-1	01/28/01	820		802	1	Schedule 40 galvanized steel pipe	578 - 609	2-1	gamma ray, bulk density, caliper, resistance	819	01/27/01
										64" normal resistivity, 16" normal resistivity, SP	822	01/27/01
										temperature, differential temperature	822	01/27/01
										gamma ray, casing collar locator	763	09/27/01
	MW 34-9-7-2	04/25/02	570	359 - 374 498 - 513 578 - 593	561	1.5	Oilfield steel tubing	496 - 526	2-2	gamma ray, casing collar locator	550	05/02/02
South Fork Texas Creek	MW 35-7-8-1	09/20/01	486		463	1.6	Schedule 40 galvanized steel pipe	403 - 416	2-1	gamma ray, bulk density, caliper, resistance	485	09/19/01
										64" normal resistivity, 16" normal resistivity, SP	485	09/19/01
										temperature, differential temperature	485	09/19/01
										gamma ray, casing collar locator	462	09/27/01
	MW 35-7-8-2	09/21/01	420	410 - 425	425	1.6	Schedule 40 galvanized steel pipe	235 - 241 254 - 258 264 - 274	2-1	gamma ray, casing collar locator	420	09/27/01
Beaver Creek Ranch	MW 35-6-17-1	04/04/02	1,645	1,457 - 1,467 1,564 - 1,572	1,631	1.5	Oilfield steel tubing	1,572 - 1,576 1,582 - 1,584	2-4	64" normal resistivity, 16" normal resistivity, SP	1,645	04/03/02
										temperature, differential temperature	1,640	04/03/02
										gamma ray, bulk density, caliper, resistance	1,643	04/03/02
										gamma ray, casing collar locator	1,618	05/02/02
	MW 35-6-17-2	10/04/01	1,550		1,500	2	Schedule 40 galvanized steel pipe	1,437 - 1,449 1,458 - 1,472	2-3	gamma ray, neutron	1,499	10/10/01
										temperature, 4Pi density	1,493	11/14/01
										signal amplitude, travel time \ D T, VDL	1,484	11/14/01
										gamma ray, casing collar locator	1,483	11/27/01
Shamrock Mines	MW 35-6-13-1	05/07/02	627		606	1.5	Oilfield steel tubing	507 - 511 517 - 533 539 - 562	2-2	gamma ray, bulk density, caliper, resistance	626	05/06/02
										64" normal resistivity, 16" normal resistivity, SP	626	05/06/02
										gamma ray, casing collar locator	626	05/10/02



NOTES

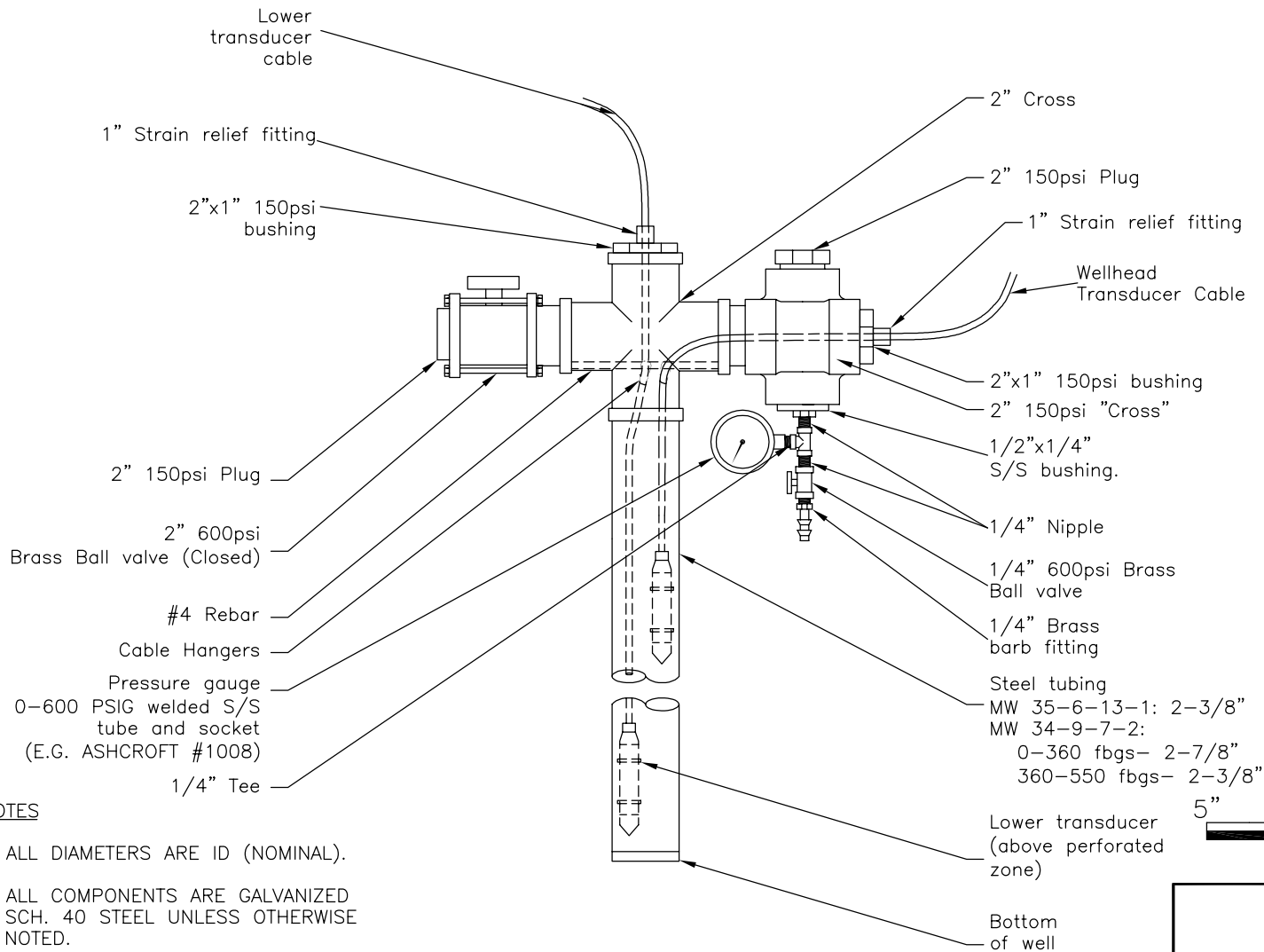
1. ALL DIAMETERS ARE ID (NOMINAL).
2. ALL COMPONENTS ARE GALVANIZED SCH. 40 STEEL UNLESS OTHERWISE NOTED.
3. ALL SAME-METAL THREADED CONNECTIONS ARE PROTECTED WITH PIPE JOINT COMPOUND OR TEFLON PIPE TAPE.
4. ALL DISSIMILAR-METAL THREADED CONNECTIONS ARE PROTECTED WITH TEFLON PIPE TAPE.



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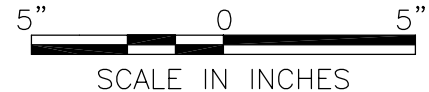
**FIGURE 2-1
BASIN CREEK MW 34-9-7-1
AND SOUTH FORK
TEXAS CREEK MW 35-7-8-1 &
MW 35-7-8-2
WELLHEAD CONSTRUCTION**

DESIGNED BY: JAMT	DATE: 6/11/02	FILE NAME: MW-34-9-7-1.dwg
DRAWN BY: JLS	PROJECT NUMBER: 66-02	SCRIPT FILE NAME:



NOTES

1. ALL DIAMETERS ARE ID (NOMINAL).
2. ALL COMPONENTS ARE GALVANIZED SCH. 40 STEEL UNLESS OTHERWISE NOTED.
3. ALL SAME-METAL THREADED CONNECTIONS ARE PROTECTED WITH PIPE JOINT COMPOUND OR TEFLON PIPE TAPE.
4. ALL DISSIMILAR-METAL THREADED CONNECTIONS ARE PROTECTED WITH TEFLON PIPE TAPE.



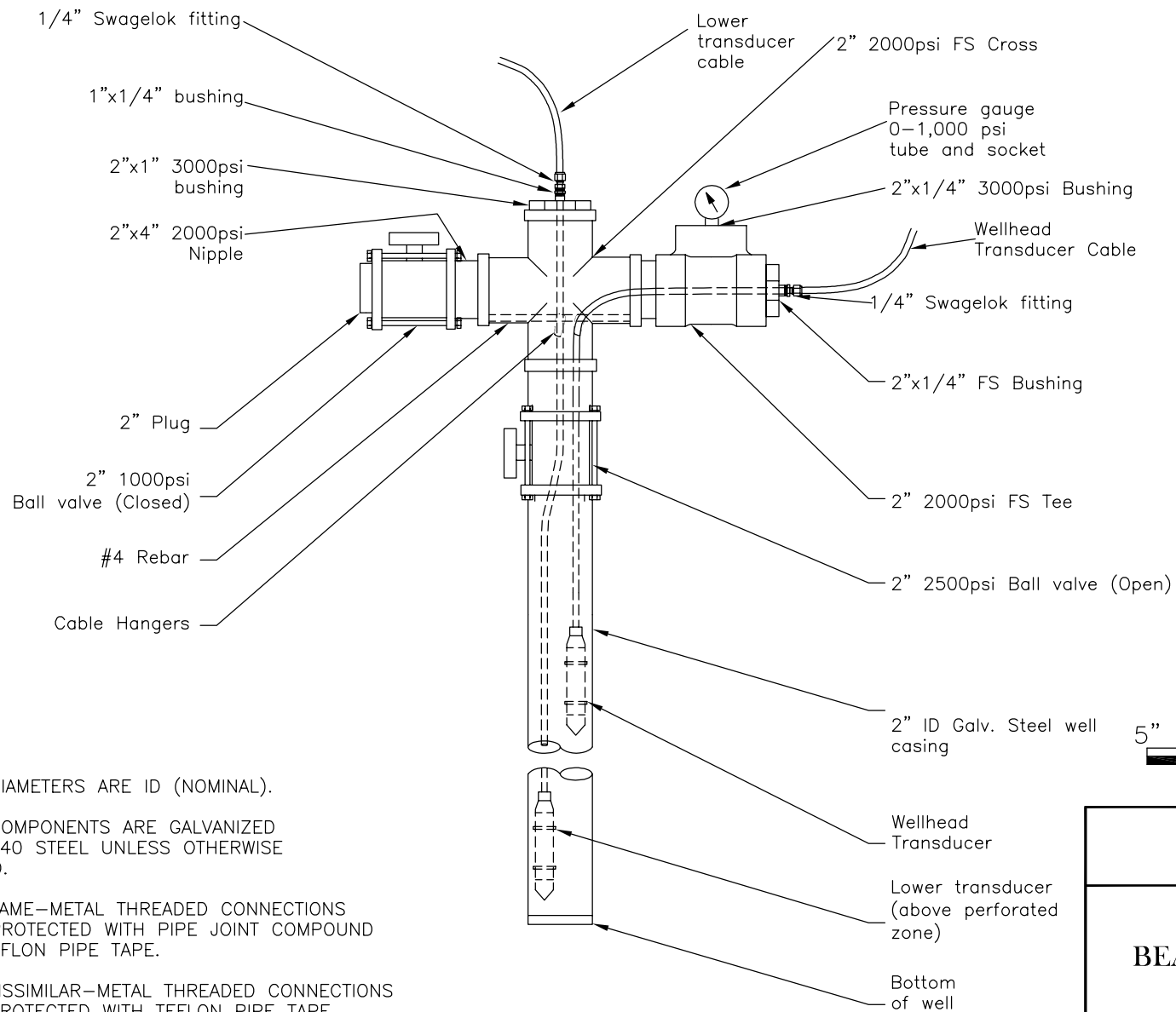
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La Plata County, CO

**FIGURE 2-2
SHAMROCK MINES
MW 35-6-13-1
AND BASIN CREEK
MW 34-9-7-2 WELLHEAD
CONSTRUCTION**



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Associates, Inc.**

DESIGNED BY: EJS	DATE: 5/9/02	FILE NAME: MW-35-6-13-1.dwg
DRAWN BY: JLS	PROJECT NUMBER: 66-02	SCRIPT FILE NAME:



NOTES

1. ALL DIAMETERS ARE ID (NOMINAL).
2. ALL COMPONENTS ARE GALVANIZED SCH. 40 STEEL UNLESS OTHERWISE NOTED.
3. ALL SAME-METAL THREADED CONNECTIONS ARE PROTECTED WITH PIPE JOINT COMPOUND OR TEFLON PIPE TAPE.
4. ALL DISSIMILAR-METAL THREADED CONNECTIONS ARE PROTECTED WITH TEFLON PIPE TAPE.



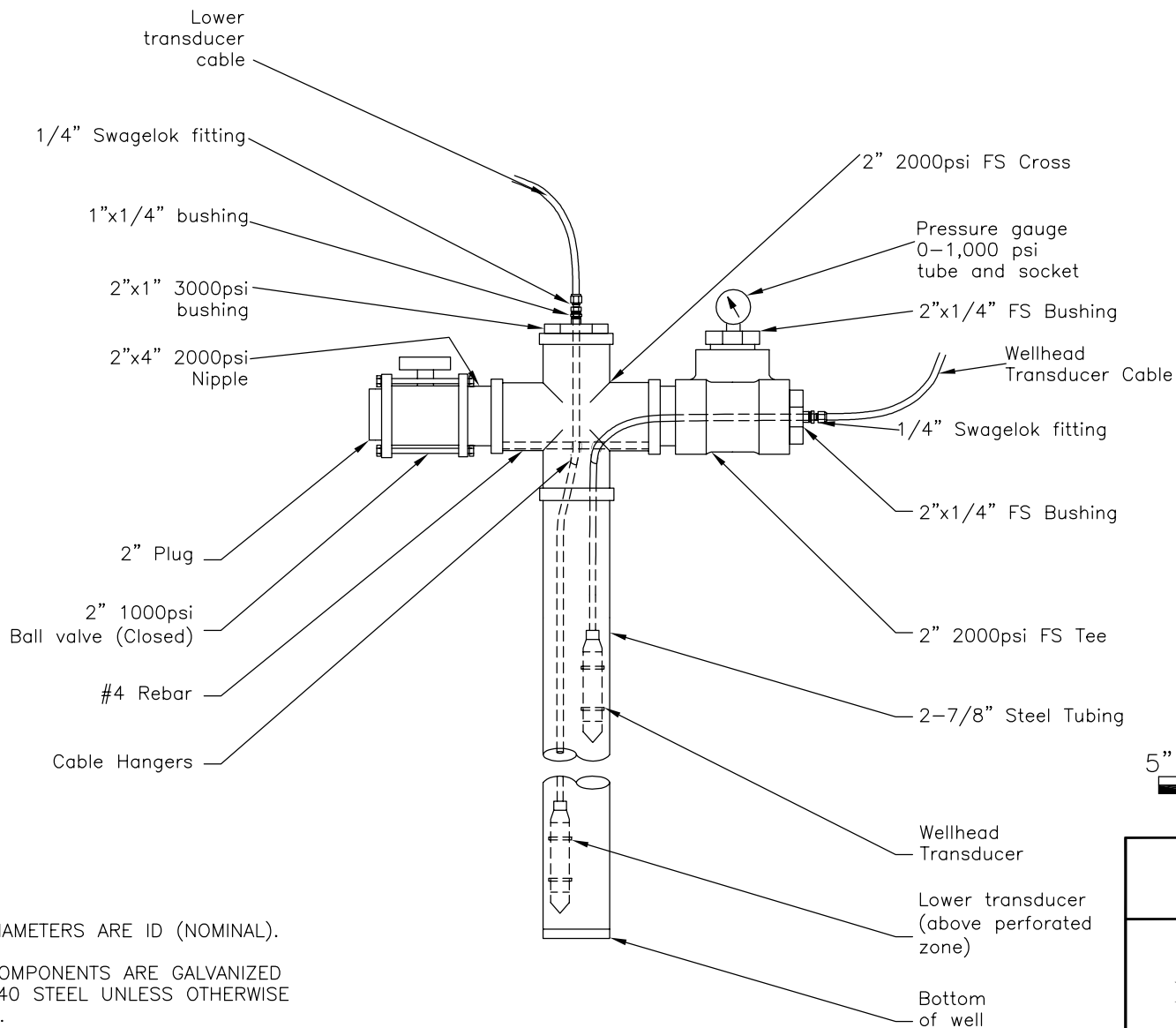
SCALE IN INCHES

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La Plata County, CO

FIGURE 2-3
BEAVER CREEK RANCH
MW 35-6-17-2
WELLHEAD
CONSTRUCTION

DESIGNED BY: NLH	DATE: 5/9/02	FILE NAME: MW-35-6-17-2.dwg
JLS	PROJECT NUMBER: 66-02	SCRIPT FILE NAME:





NOTES

1. ALL DIAMETERS ARE ID (NOMINAL).
2. ALL COMPONENTS ARE GALVANIZED SCH. 40 STEEL UNLESS OTHERWISE NOTED.
3. ALL SAME-METAL THREADED CONNECTIONS ARE PROTECTED WITH PIPE JOINT COMPOUND OR TEFLON PIPE TAPE.
4. ALL DISSIMILAR-METAL THREADED CONNECTIONS ARE PROTECTED WITH TEFLON PIPE TAPE.



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3M Project La Plata County, CO		
FIGURE 2-4 BEAVER CREEK RANCH MW 35-6-17-1 WELLHEAD CONSTRUCTION		
DESIGNED BY: EJS	DATE: 5/9/02	FILE NAME: MW-35-6-17-1.dwg
DRAWN BY: JLS	PROJECT NUMBER: 66-02	SCRIPT FILE NAME:

3.0 MONITORING EQUIPMENT

3.1 Monitoring System

Monitoring system components at each site include In-Situ brand pressure transducers, vented or non-vented transducer cables, Hermit 3000 data logger, and telemetry system. Each telemetry system includes a solar panel, lead-sulfate deep-cycle battery, Motorola modem and handset, and ASC brand switches for power control. (See Photos 4 through 7 in Appendix B.).

Appendix C includes the procedure for downloading data via telemetry (Tab C-1) and all monitoring and telemetry equipment operation manuals (Tabs C-2 through C-9).

3.2 System Installation

Each well is fitted with two pressure transducers, an upper transducer approximately 5 ft. below ground surface and a lower transducer set a few feet above the perforated interval. Each transducer pressure rating is in accordance with actual well-specific pressure ranges and depth (Table 3-1).

Transducer cable ports in the low-pressure wellheads are sealed with strain relief fittings (Figures 2-1 and 2-2). At Beaver Creek Ranch, the MW 35-6-17-1 and MW 35-6-17-2 transducer cable ports are sealed with high-pressure rated Swagelok fittings (Appendix C-10 and Figures 2-3 and 2-4).

Solar panels and antennae for the telemetry systems are mounted on the top of sturdy monitoring equipment sheds provided by BP America. Other telemetry system components (power box, cellular phone and modem), and data loggers are mounted inside the sheds. Well pressure transducer cables connected to the data loggers are protected in buried conduit between each shed and well pad. (See Photos 4 through 7 in Appendix B.)

**Table 3-1
Monitoring Well Equipment Installation**

Location	Well ID	Upper Transducer		Lower Transducer		
		Depth (fbgs)	Type and Rating	Depth (fbgs)	Feet above Perforated Interval	Type and Rating
Basin Creek	MW 34-9-7-1	0.5	PXD-261-30 psig	570	8	PXD-461-500 psia
	MW 34-9-7-2	5	PXD-461-500 psia	485	11	PXD-461-500 psia
South Fork Texas Creek	MW 35-7-8-1	5	PXD-261-30 psig	390	13	PXD-461-500 psia
	MW 35-7-8-2	4	PXD-461-500 psia	225	10	PXD-461-500 psia
Beaver Creek Ranch	MW 35-6-17-1	5	PXD-461-500 psia	1,565	7	PXD-461-1,000 psia
	MW 35-6-17-2	5	PXD-461-1,000 psia	1,420	17	PXD-461-1,000 psia
Shamrock Mines	MW 35-6-13-1	5	PXD-461-500 psia	500	7	PXD-461-1,000 psia

APPENDIX A

Well Installation Reports

Basin Creek

MW 34-9-7-1

MW 34-9-7-2

South Fork Texas Creek

MW 35-7-8-1

MW 35-7-8-2

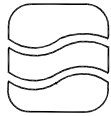
Beaver Creek Ranch

MW 35-6-17-1

MW 35-6-17-2

Shamrock Mines

MW 35-6-13-1



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Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, K. Ritter
 Date Started : 1/24/01
 Date Completed : 1/28/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 820fbs

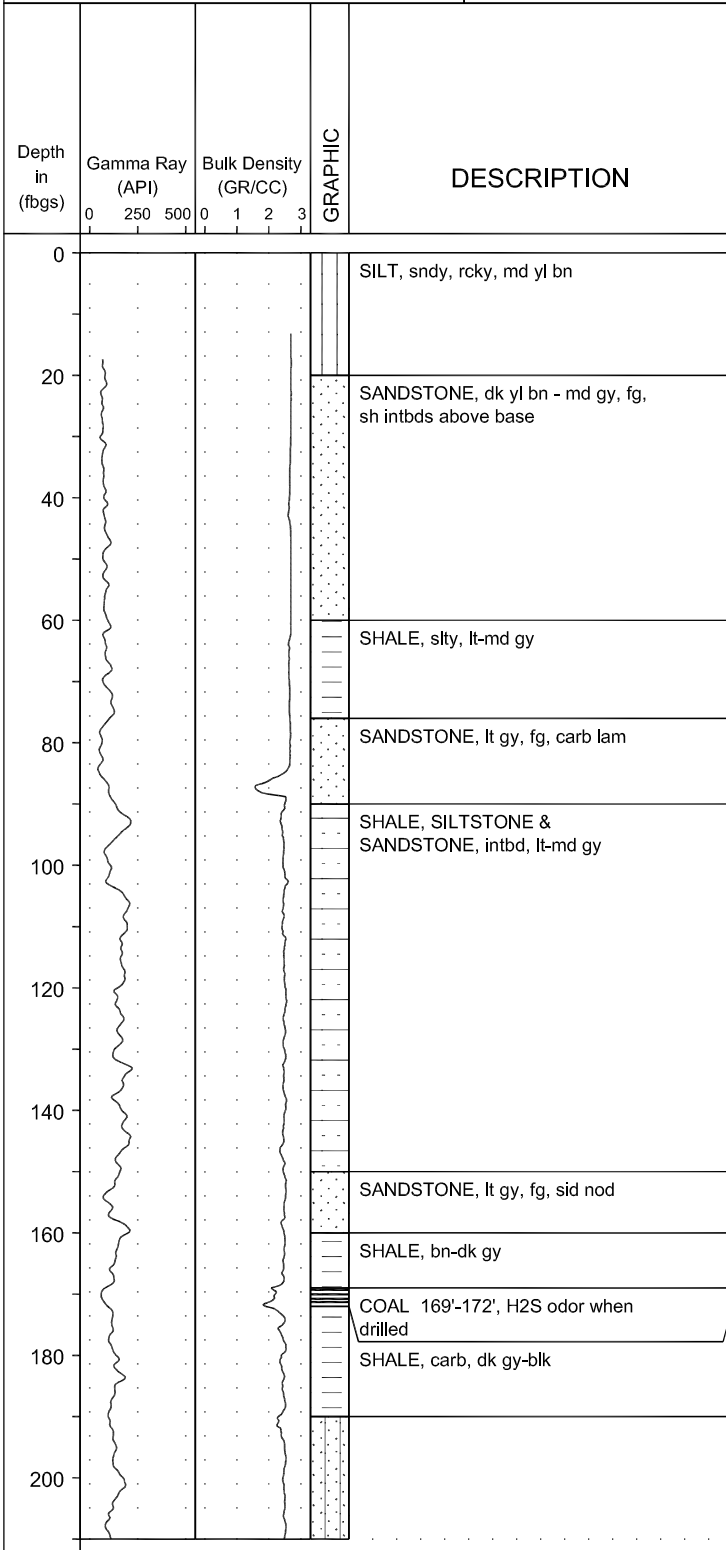
MW 34-9-7-1

(Page 1 of 4)

TOC Elev. (ft. AMSL) : N/A
 Top of Pad Elev. : 2035.94m, 6679.61ft
 Northing Coord. : 4122811.13m
 Easting Coord. : 243837.80m

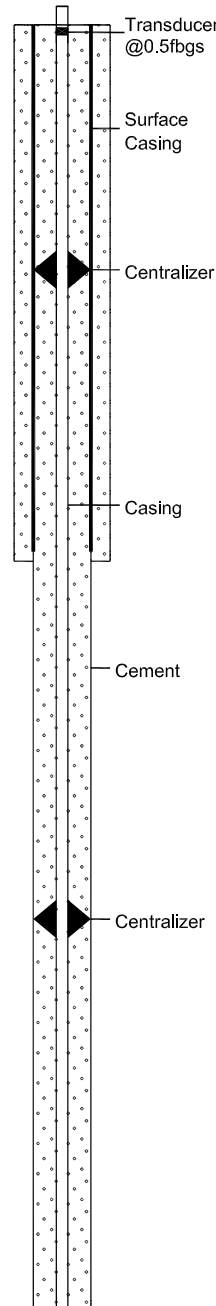
**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BASIN CREEK



Well: MW 34-9-7-1
Elev.: 6679.61ft

Well Construction Information



SURFACE CASING

Hole Diameter : 9.875in
 Drill Method : Air Rotary w/ Foam
 Casing Material : Steel
 Casing Depth : 86fbs
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 6.25in
 Drill method : Air Rotary w/ Foam

WELL CASING

Casing Depth : 802fbs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2/ft
 Interval : 578-609 fbs
 Annulus Seal : Cement

WELL SUMP

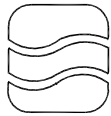
Material : Galvanized Steel
 Diameter : 2in
 Annulus Seal : Cement

NOTES

LOCATION:
 NE1/4, SE1/4, Sec 7, T34N, R9W
 La Plata County

Cored Intervals: 359-374, 498-513, and 578-593 fbs; Core cut in abandoned hole 2.

Pressure Transducers (fbs):
 0.5 & 570



**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, K. Ritter
 Date Started : 1/24/01
 Date Completed : 1/28/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 820fbgs

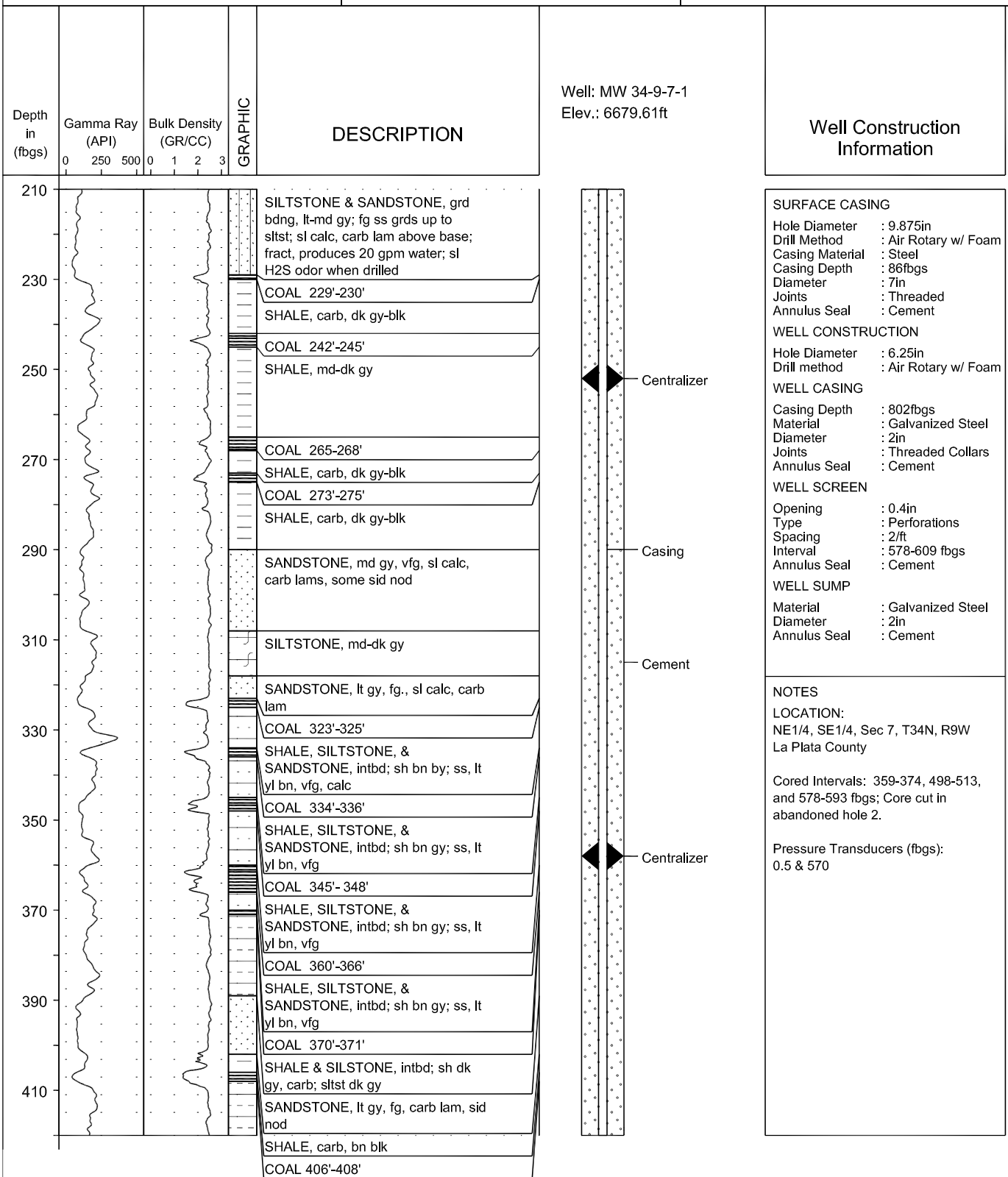
MW 34-9-7-1

(Page 2 of 4)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2035.94m, 6679.61ft
 Northing Coord. : 4122811.13m
 Easting Coord. : 243837.80m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BASIN CREEK



SURFACE CASING
 Hole Diameter : 9.875in
 Drill Method : Air Rotary w/ Foam
 Casing Material : Steel
 Casing Depth : 86fbgs
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION
 Hole Diameter : 6.25in
 Drill method : Air Rotary w/ Foam

WELL CASING
 Casing Depth : 802fbgs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars
 Annulus Seal : Cement

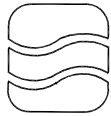
WELL SCREEN
 Opening : 0.4in
 Type : Perforations
 Spacing : 2/ft
 Interval : 578-609 fbgs
 Annulus Seal : Cement

WELL SUMP
 Material : Galvanized Steel
 Diameter : 2in
 Annulus Seal : Cement

NOTES
 LOCATION:
 NE1/4, SE1/4, Sec 7, T34N, R9W
 La Plata County

Cored Intervals: 359-374, 498-513, and 578-593 fbgs; Core cut in abandoned hole 2.

Pressure Transducers (fbgs):
 0.5 & 570



**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, K. Ritter
 Date Started : 1/24/01
 Date Completed : 1/28/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 820fbs

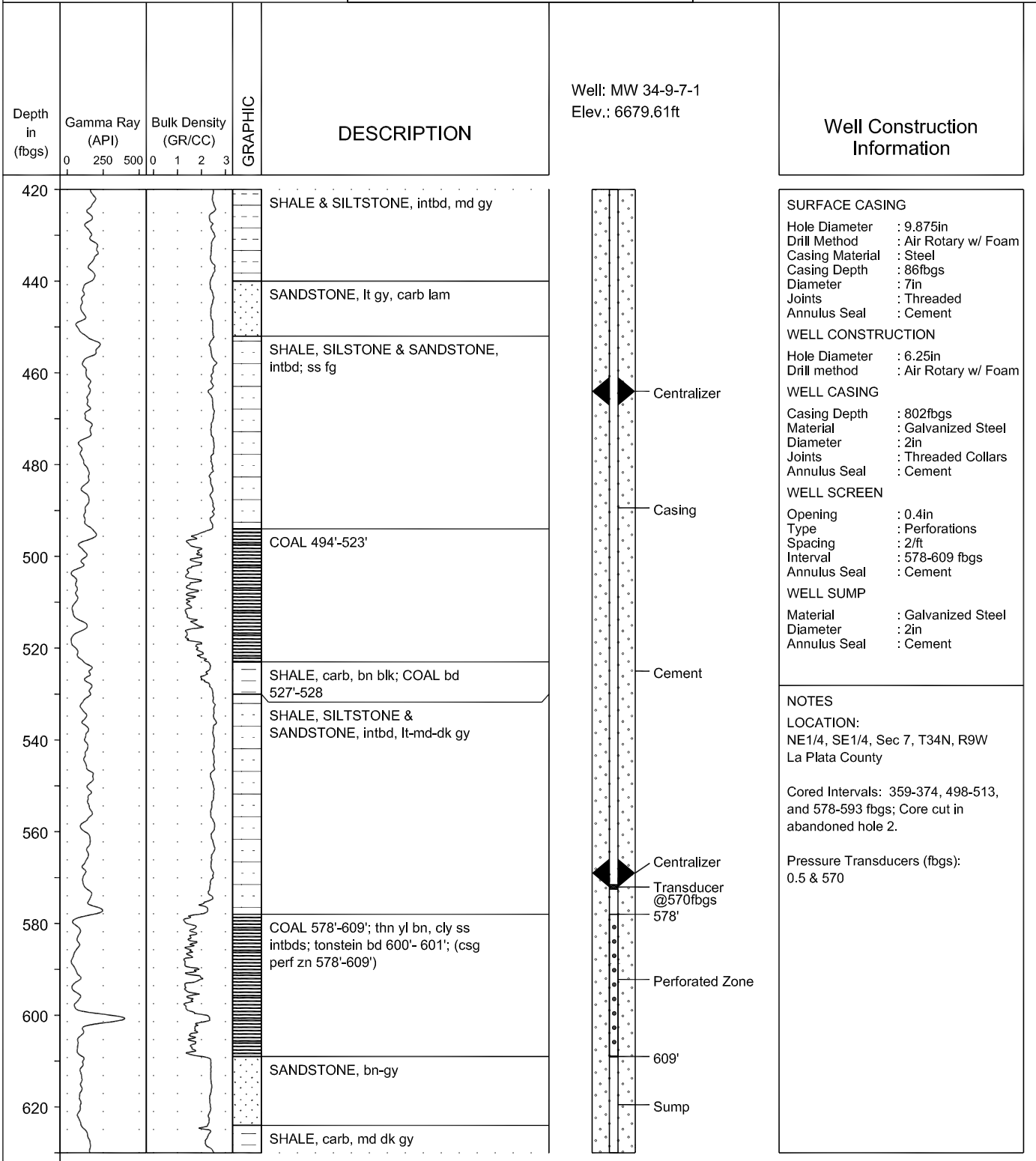
MW 34-9-7-1

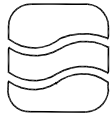
(Page 3 of 4)

TOC Elev. (ft. AMSL) : N/A
 Top of Pad Elev. : 2035.94m, 6679.61ft
 Northing Coord. : 4122811.13m
 Easting Coord. : 243837.80m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BASIN CREEK





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, K. Ritter
 Date Started : 1/24/01
 Date Completed : 1/28/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 820fbgs

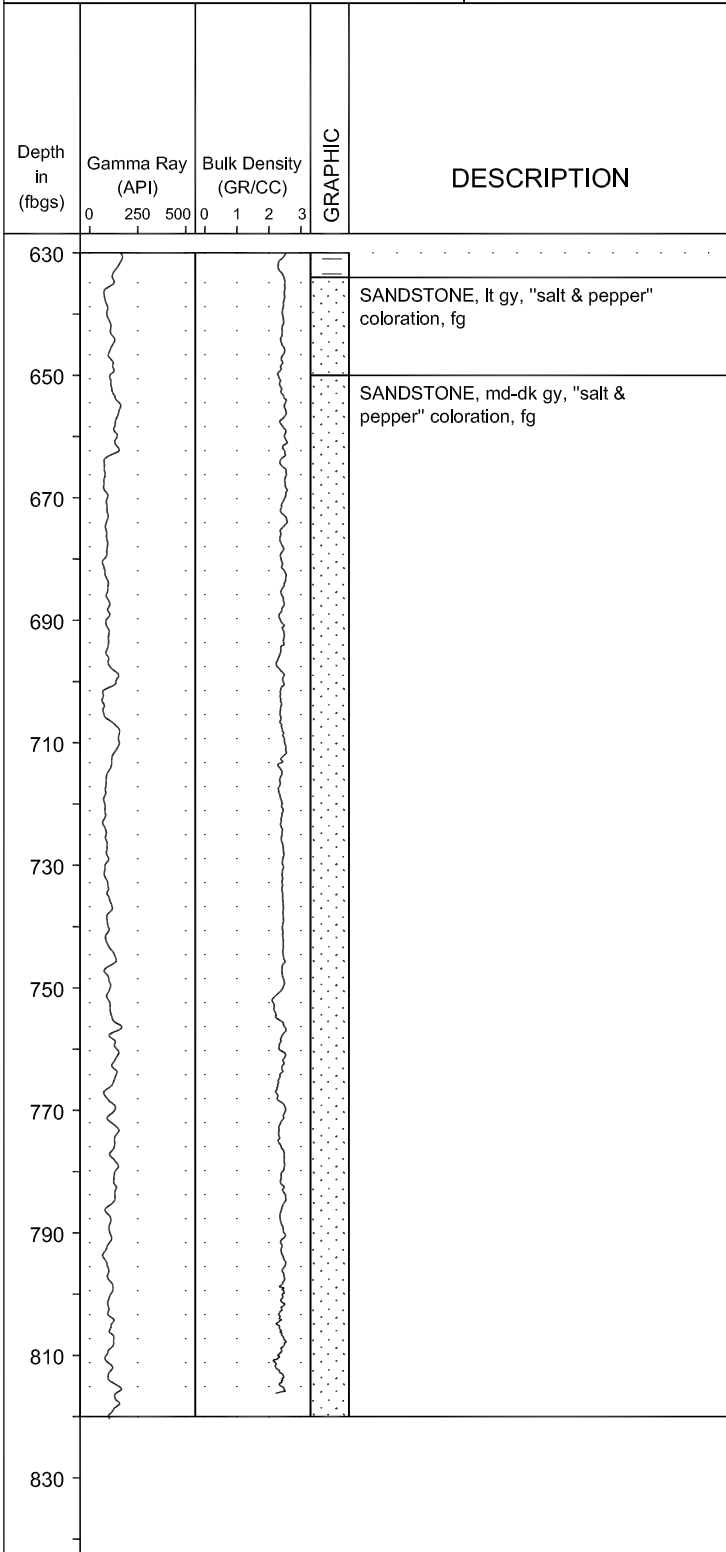
MW 34-9-7-1

(Page 4 of 4)

TOC Elev. (ft. AMSL) : N/A
 Top of Pad Elev. : 2035.94m, 6679.61ft
 Northing Coord. : 4122811.13m
 Easting Coord. : 243837.80m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BASIN CREEK



Well: MW 34-9-7-1
Elev.: 6679.61ft

Well Construction Information

SURFACE CASING

Hole Diameter : 9.875in
 Drill Method : Air Rotary w/ Foam
 Casing Material : Steel
 Casing Depth : 86fbgs
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 6.25in
 Drill method : Air Rotary w/ Foam

WELL CASING

Casing Depth : 802fbgs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2/ft
 Interval : 578-609 fbgs
 Annulus Seal : Cement

WELL SUMP

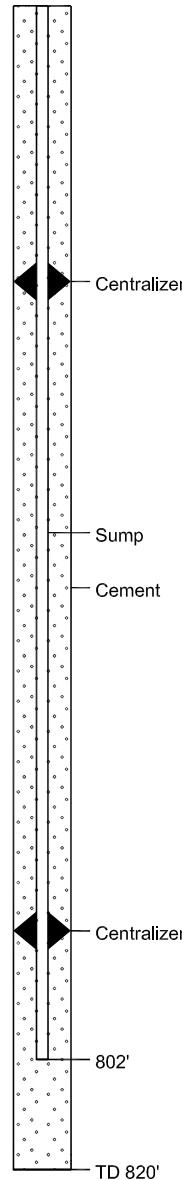
Material : Galvanized Steel
 Diameter : 2in
 Annulus Seal : Cement

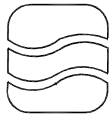
NOTES

LOCATION:
 NE1/4, SE1/4, Sec 7, T34N, R9W
 La Plata County

Cored Intervals: 359-374, 498-513, and 578-593 fbgs; Core cut in abandoned hole 2.

Pressure Transducers (fbgs):
 0.5 & 570





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 4/24/02
 Date Completed : 4/25/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 570fbgs

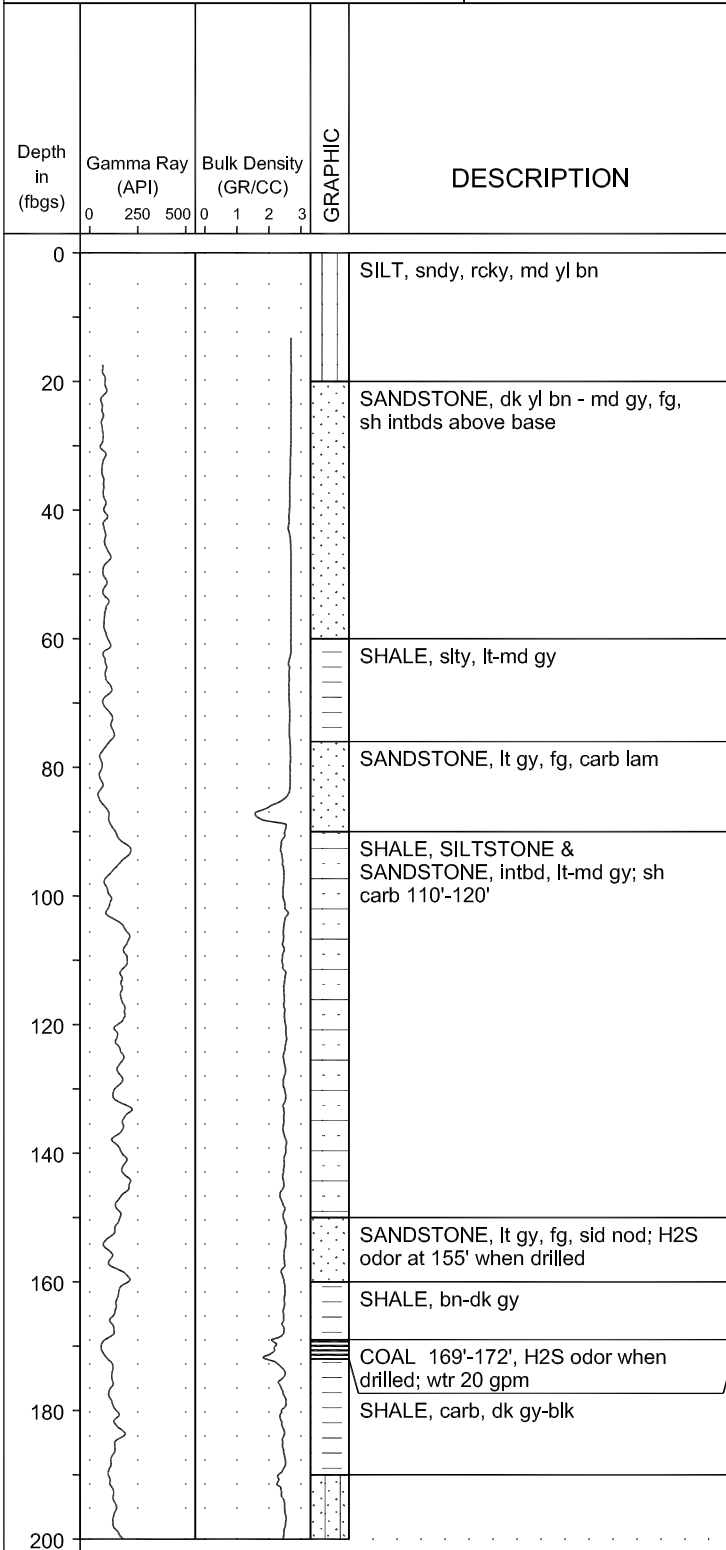
MW 34-9-7-2

(Page 1 of 3)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2036.77m, 6682.32ft
 Northing Coord. : 4122817.80m
 Easting Coord. : 243843.60m

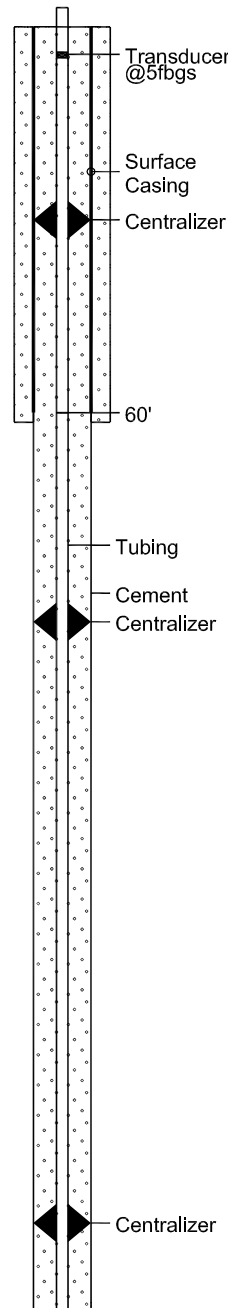
3M PROJECT
 COGCC
 MONITORING WELL CONSTRUCTION

AREA: BASIN CREEK



Well: MW 34-9-7-2
 Elev.: 6682.32

Well Construction Information



SURFACE CASING

Hole Diameter : 9.5in
 Drill Method : Air Rotary w/ Foam
 Casing Material : Steel
 Casing Depth : 60fbgs
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 6.25in
 Drill method : Air Rotary w/ Foam

WELL CASING

Casing Depth : 562fbgs
 Material : Steel Tubing
 Diameter #1 : 2.875in (1.5'-373')
 Diameter #2 : 2.375in (373'-562')
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2/ft
 Interval : 496-526 fbgs
 Annulus Seal : Cement

WELL SUMP

Material : Steel Tubing
 Diameter : 2.375in O.D.
 Annulus Seal : Cement

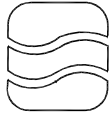
NOTES

LOCATION:
 NE1/4, SE1/4, Sec 7, T34N, R9W
 La Plata County

Cored Intervals (fbgs):
 Abandoned hole 2; 359-374,
 498-513, and 578-593

Gamma Ray & Bluk Density Logs for
 MW 34-9-2-1

Pressure Transducers (fbgs):
 5 & 485



**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 4/24/02
 Date Completed : 4/25/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 570fbgs

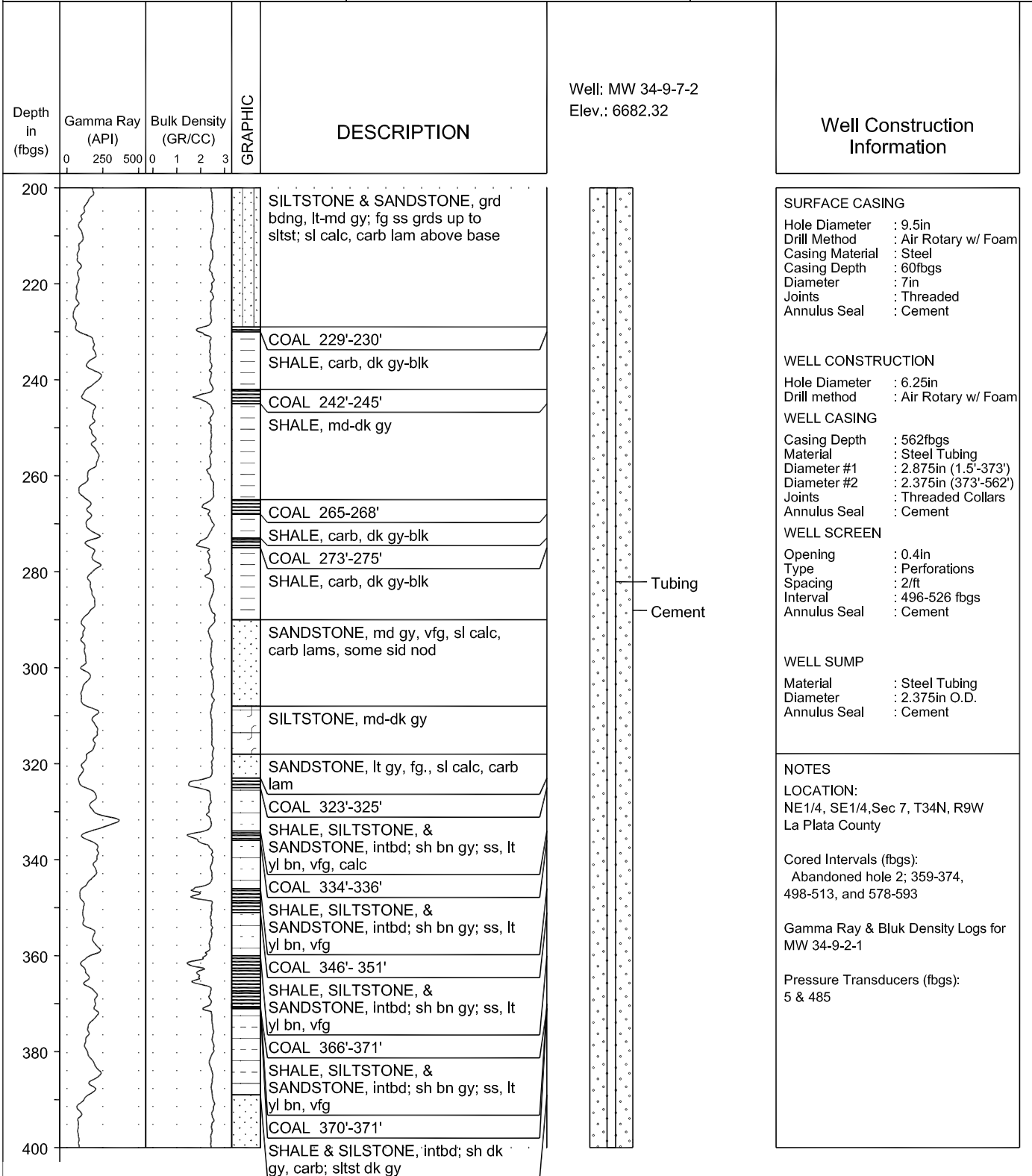
MW 34-9-7-2

(Page 2 of 3)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2036.77m, 6682.32ft
 Northing Coord. : 4122817.80m
 Easting Coord. : 243843.60m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BASIN CREEK



SURFACE CASING

Hole Diameter : 9.5in
 Drill Method : Air Rotary w/ Foam
 Casing Material : Steel
 Casing Depth : 60fbgs
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 6.25in
 Drill method : Air Rotary w/ Foam

WELL CASING

Casing Depth : 562fbgs
 Material : Steel Tubing
 Diameter #1 : 2.875in (1.5'-373')
 Diameter #2 : 2.375in (373'-562')
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2/ft
 Interval : 496-526 fbgs
 Annulus Seal : Cement

WELL SUMP

Material : Steel Tubing
 Diameter : 2.375in O.D.
 Annulus Seal : Cement

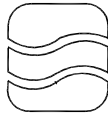
NOTES

LOCATION:
 NE1/4, SE1/4, Sec 7, T34N, R9W
 La Plata County

Cored Intervals (fbgs):
 Abandoned hole 2: 359-374,
 498-513, and 578-593

**Gamma Ray & Bluk Density Logs for
 MW 34-9-2-1**

Pressure Transducers (fbgs):
 5 & 485



**Applied
Hydrology
Associates, Inc.**

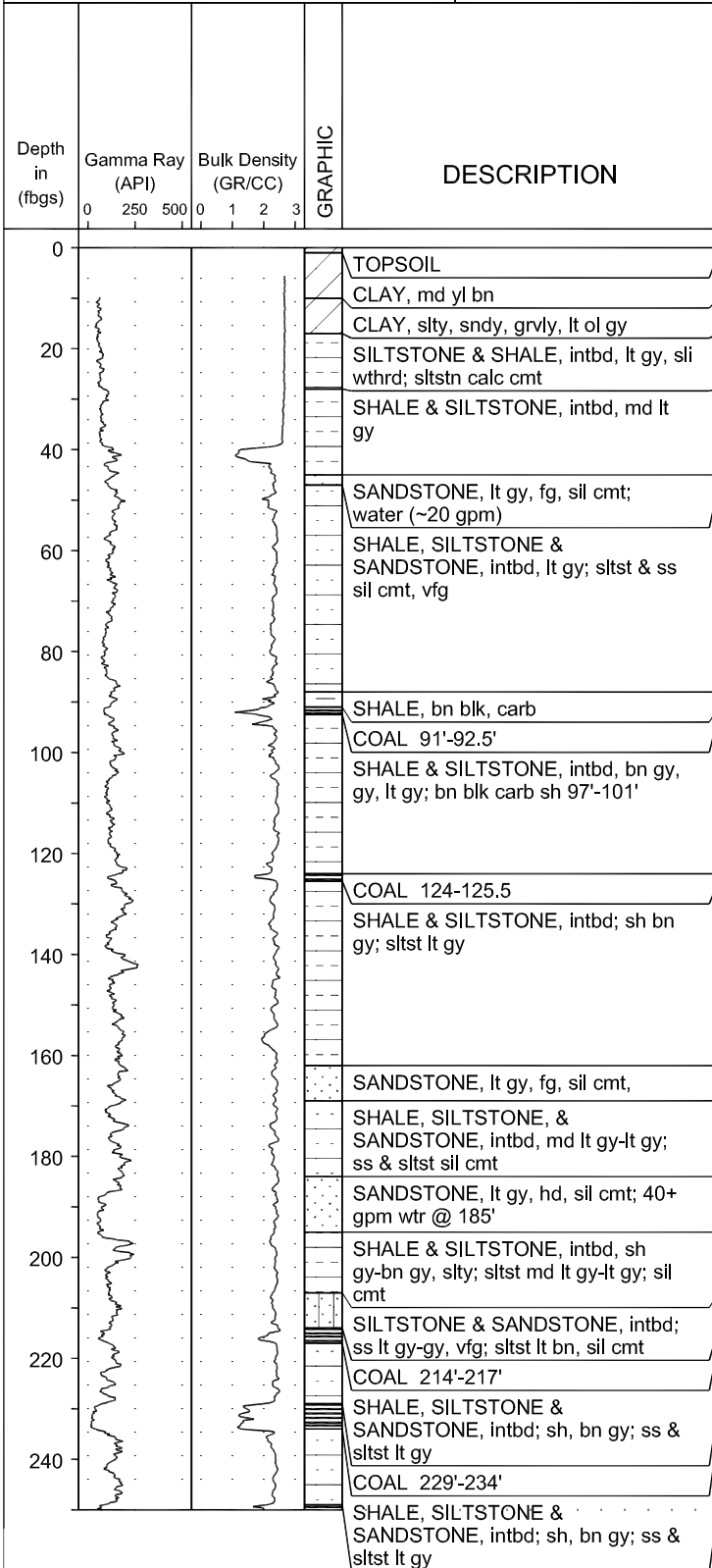
Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/17/01
 Date Completed : 9/20/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 486fbgs

MW 35-7-8-1

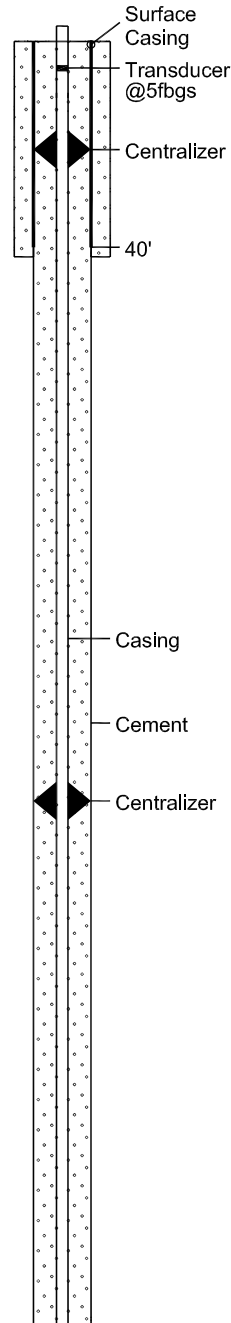
(Page 1 of 2)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2287.45m, 7504.75ft
 Northing Coord. : 4132635.41m
 Easting Coord. : 264914.46m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION
AREA: SOUTH FORK TEXAS CREEK**



Well: MW 35-7-8-1
Elev.: 7504.75ft



Well Construction Information

SURFACE CASING

Hole Diameter : 8.625in
 Drill Method : Air Rotary w/ Foam
 Casing Depth : 40fbgs
 Casing Material : Steel
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 5.625in
 Drill method : Air Rotary w/ Foam

WELL CASING

Depth : 463fbgs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2 /ft
 Interval : 403-416fbgs
 Annulus Seal : Cement

WELL SUMP

Material : Galvanized Steel
 Diameter : 2in
 Annulus Seal : Cement

NOTES

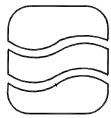
LOCATION:

NE1/4, SE1/4, Sec 8, T35N, R7W
 La Plata County

Calc. apparent dip of lowest coal bed between holes 1 and 2 is 22deg S; coal bed in hole 2 is 8ft deeper.

Cored Interval (fbgs): 410-425; core cut in MW 35-7-8-2

Pressure Transducers (fbgs): 5 & 390



**Applied
Hydrology
Associates, Inc.**

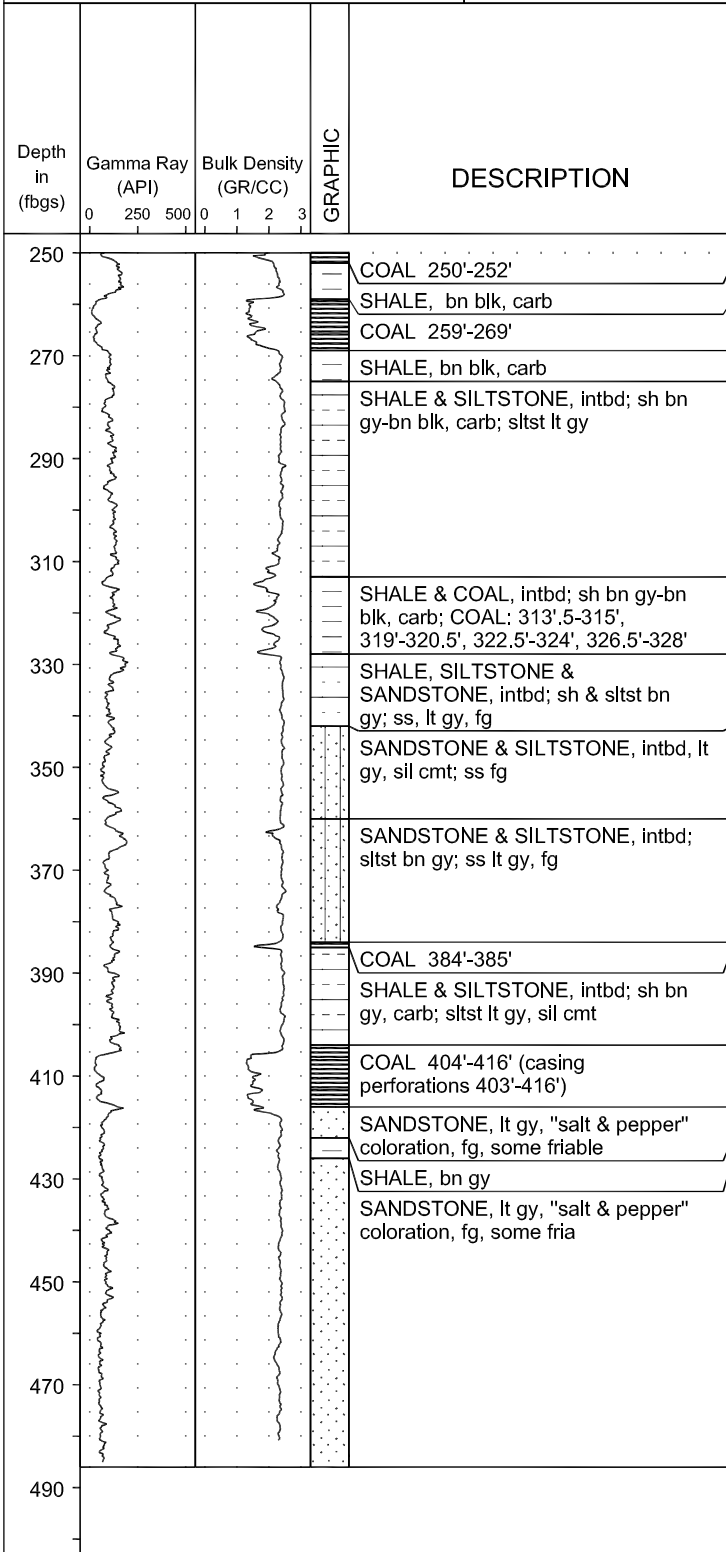
Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/17/01
 Date Completed : 9/20/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 486fbgs

MW 35-7-8-1

(Page 2 of 2)

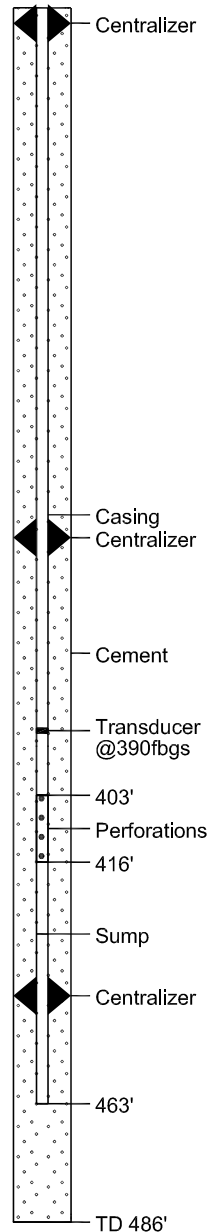
TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2287.45m, 7504.75ft
 Northing Coord. : 4132635.41m
 Easting Coord. : 264914.46m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION
AREA: SOUTH FORK TEXAS CREEK**



Well: MW 35-7-8-1
Elev.: 7504.75ft

Well Construction Information



SURFACE CASING

Hole Diameter : 8.625in
 Drill Method : Air Rotary w/ Foam
 Casing Depth : 40fbgs
 Casing Material : Steel
 Diameter : 7in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 5.625in
 Drill method : Air Rotary w/ Foam

WELL CASING

Depth : 463fbgs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2 /ft
 Interval : 403-416fbgs
 Annulus Seal : Cement

WELL SUMP

Material : Galvanized Steel
 Diameter : 2in
 Annulus Seal : Cement

NOTES

LOCATION:

NE1/4, SE1/4, Sec 8, T35N, R7W
La Plata County

Calc. apparent dip of lowest coal bed between holes 1 and 2 is 22deg S; coal bed in hole 2 is 8ft deeper.

Cored Interval (fbgs): 410-425; core cut in MW 35-7-8-2

Pressure Transducers (fbgs): 5 & 390



**Applied
Hydrology
Associates, Inc.**

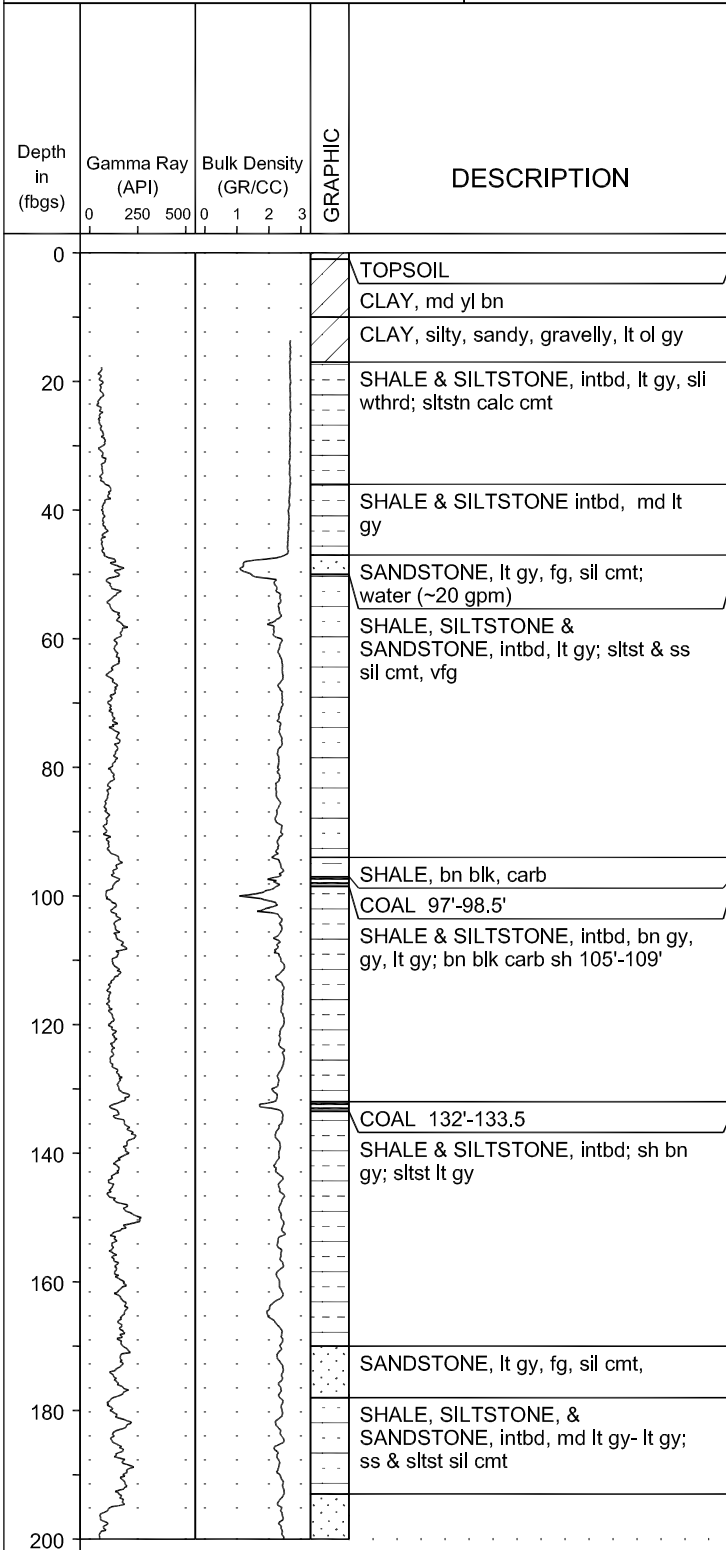
Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/20/01
 Date Completed : 9/21/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 425fbgs

MW 35-7-8-2

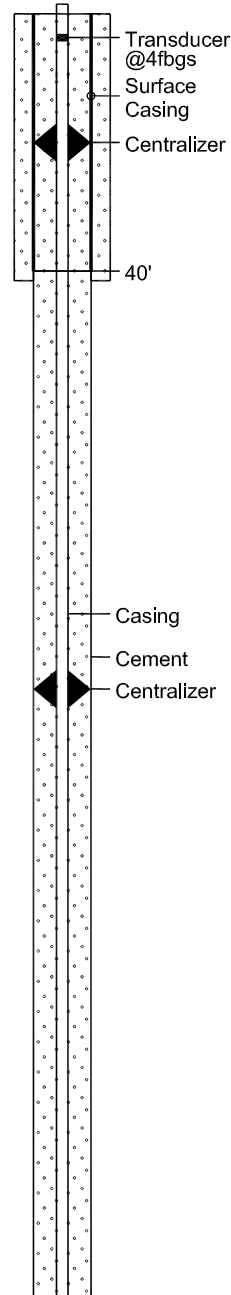
(Page 1 of 3)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2287.57m, 7505.14ft
 Northing Coord. : 4132629.25m
 Easting Coord. : 264914.04m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION
AREA: SOUTH FORK TEXAS CREEK**



Well: MW 35-7-8-2
Elev.: 7505.14ft



Well Construction Information

SURFACE CASING

Hole Diameter : 8.625in
 Drill Method : Air Rotary w/ Foam
 Casing Depth : 40fbgs
 Casing Material : Steel
 Diameter : 6.625in
 Joints : Threaded
 Annulus Seal : Cement

WELL CONSTRUCTION

Hole Diameter : 5.625in
 Drill method : Air Rotary w/ Foam

WELL CASING

Casing Depth : 420fbgs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2 /ft
 Interval : 235-241, 254-258
 : 264-274fbgs
 Annulus Seal : Cement

WELL SUMP

Material : Galvanized Steel
 Diameter : 2in
 Annulus Seal : Cement

NOTES

LOCATION:

NE1/4, SE1/4, Sec 8, T35N, R7W
 La Plata County

Gamma and density logs are for hole
 1 adjusted to match depth of coal
 intervals in hole 2.

Calc. apparent dip of lowest coal
 bed between holes 1 and 2 is 22deg
 S; contact in hole 2 is 8ft deeper.

Cored Interval (fbgs): 410-425

Pressure Transducers (fbgs):
 4 & 225



**Applied
Hydrology
Associates, Inc.**

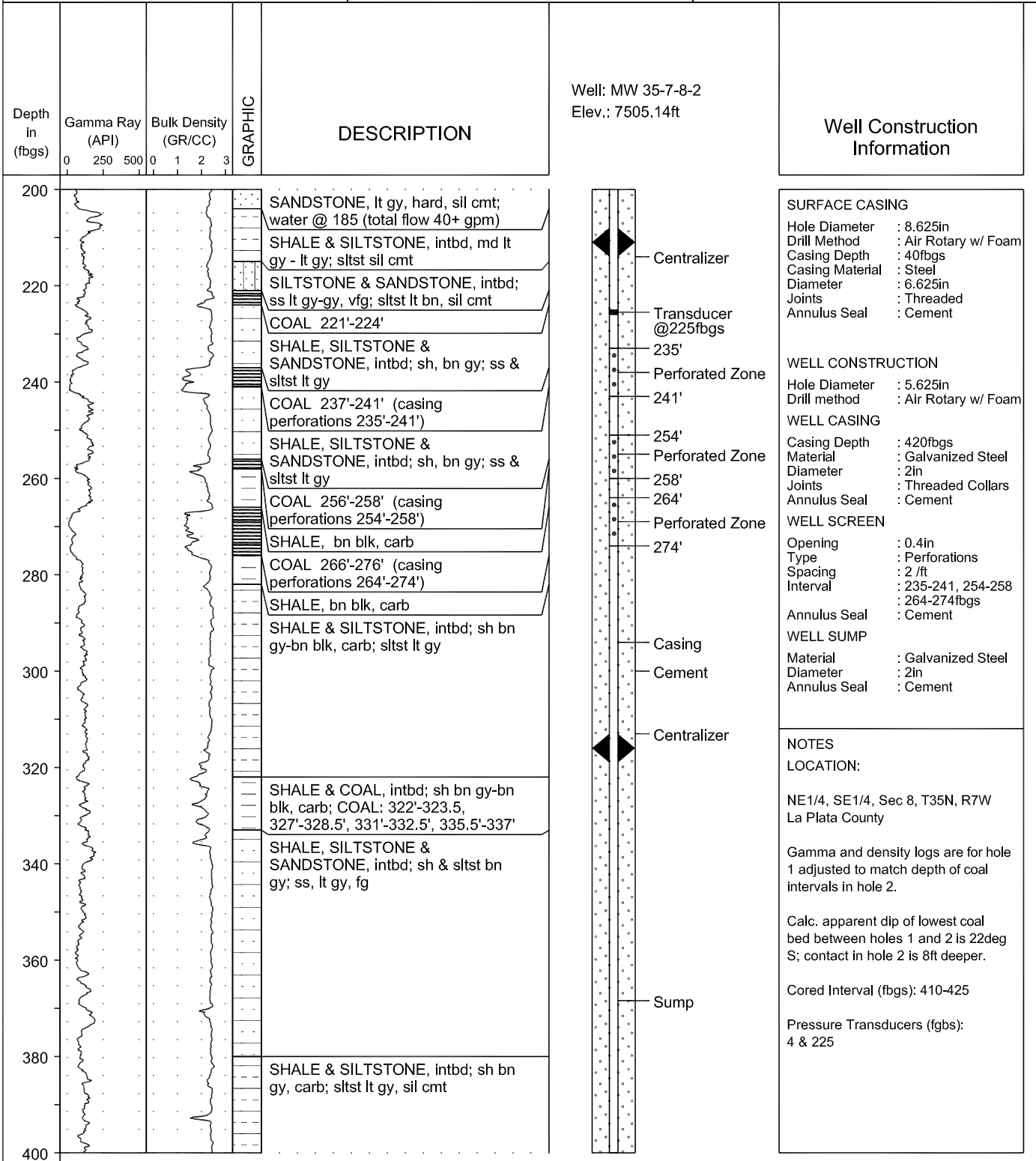
Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/20/01
 Date Completed : 9/21/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 425fbgs

MW 35-7-8-2

(Page 2 of 3)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2287.57m, 7505.14ft
 Northing Coord. : 4132629.25m
 Easting Coord. : 264914.04m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION
AREA: SOUTH FORK TEXAS CREEK**





**Applied
Hydrology
Associates, Inc.**

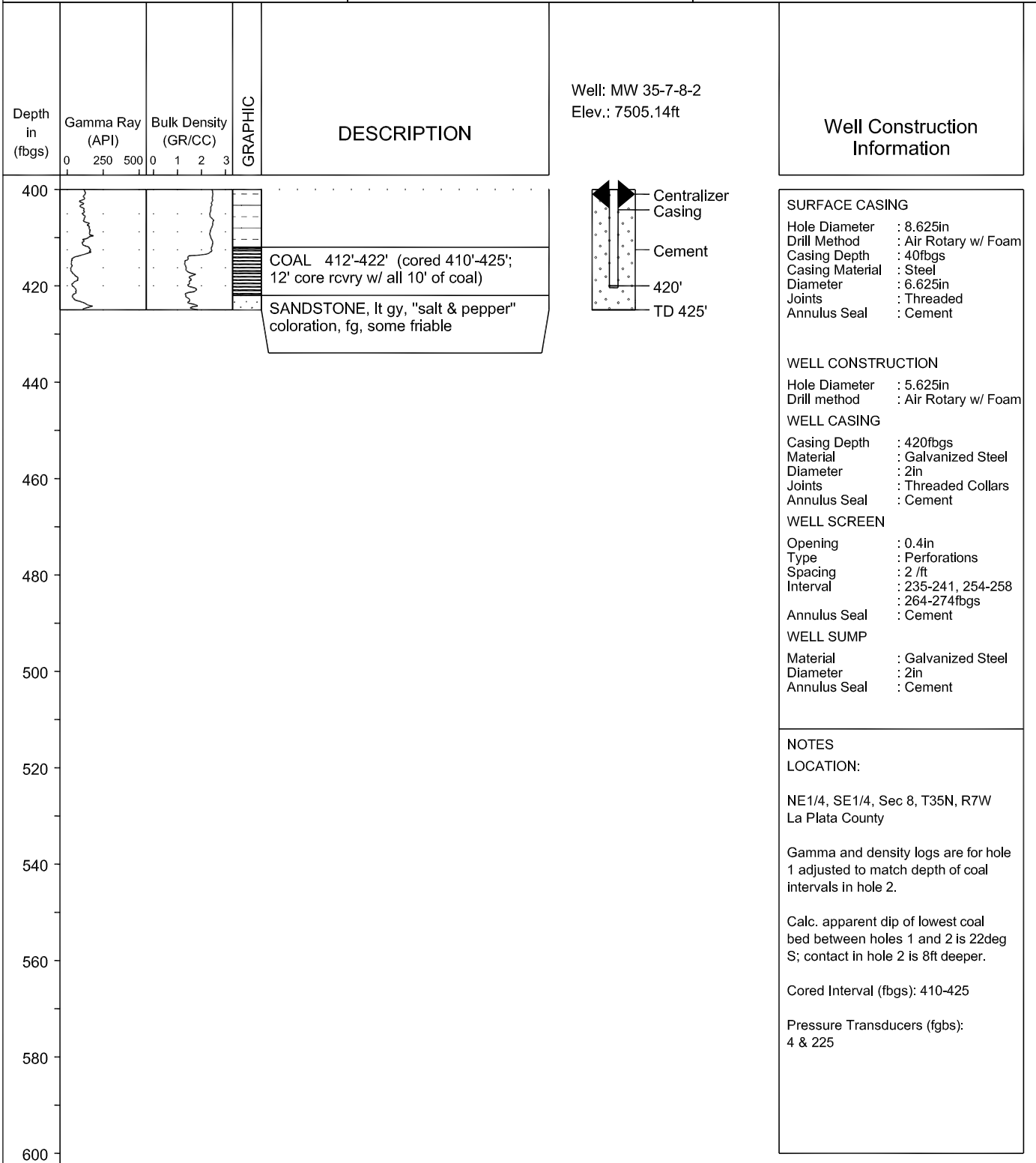
Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/20/01
 Date Completed : 9/21/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 425fbgs

MW 35-7-8-2

(Page 3 of 3)

TOC Elev. (ft, AMSL) : N/A
 Top of Pad Elev. : 2287.57m, 7505.14ft
 Northing Coord. : 4132629.25m
 Easting Coord. : 264914.04m

3M PROJECT
 COGCC
 MONITORING WELL CONSTRUCTION
 AREA: SOUTH FORK TEXAS CREEK





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 3/15/02
 Date Completed : 4/4/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 1645fbgs

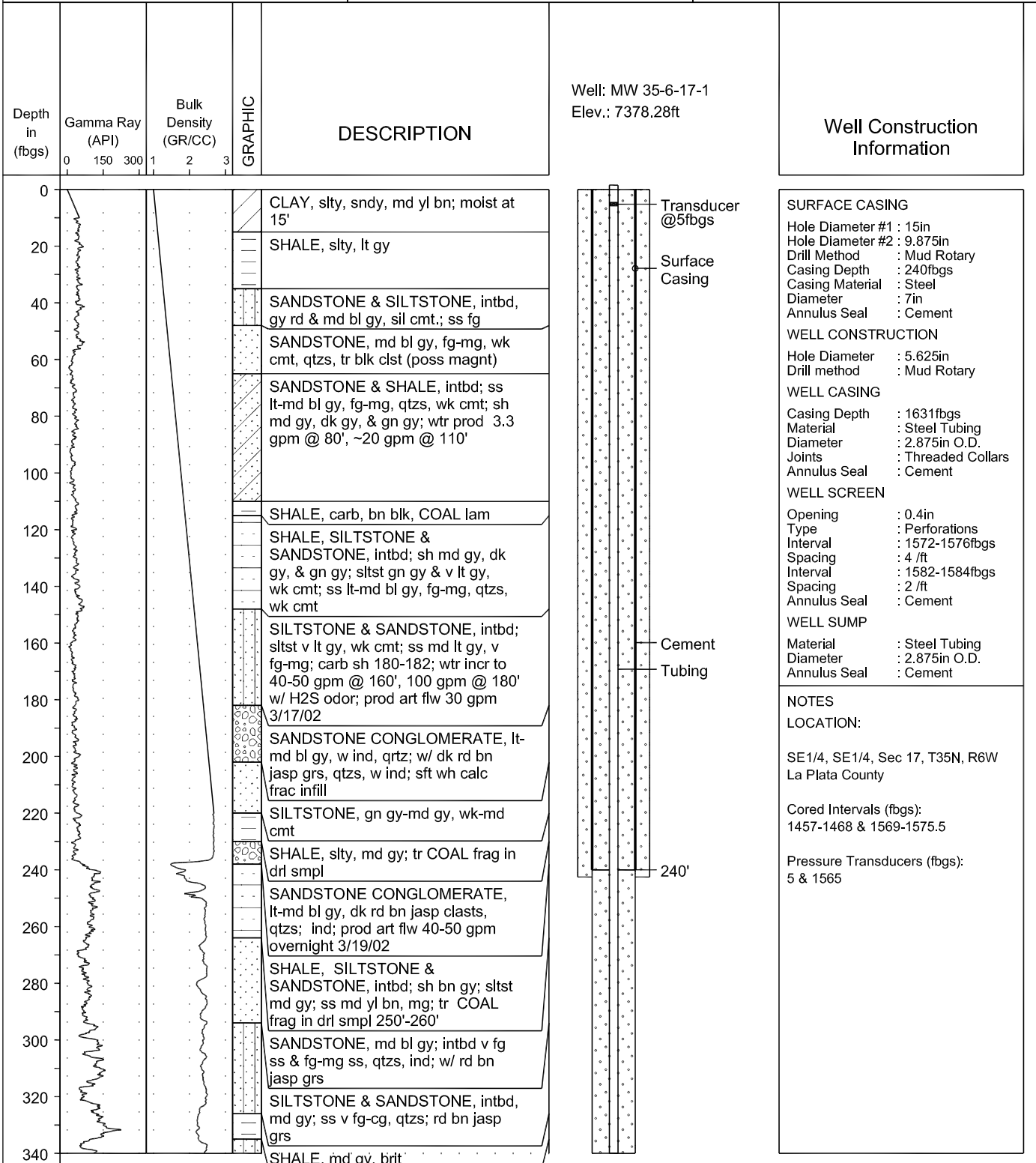
MW 35-6-17-1

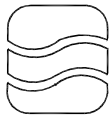
(Page 1 of 5)

TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2248.9m, 7378.28ft
 Northing Coord. : 4130475.98m
 Easting Coord. : 274373.72

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BEAVER CREEK RANCH





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 3/15/02
 Date Completed : 4/4/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 1645fbgs

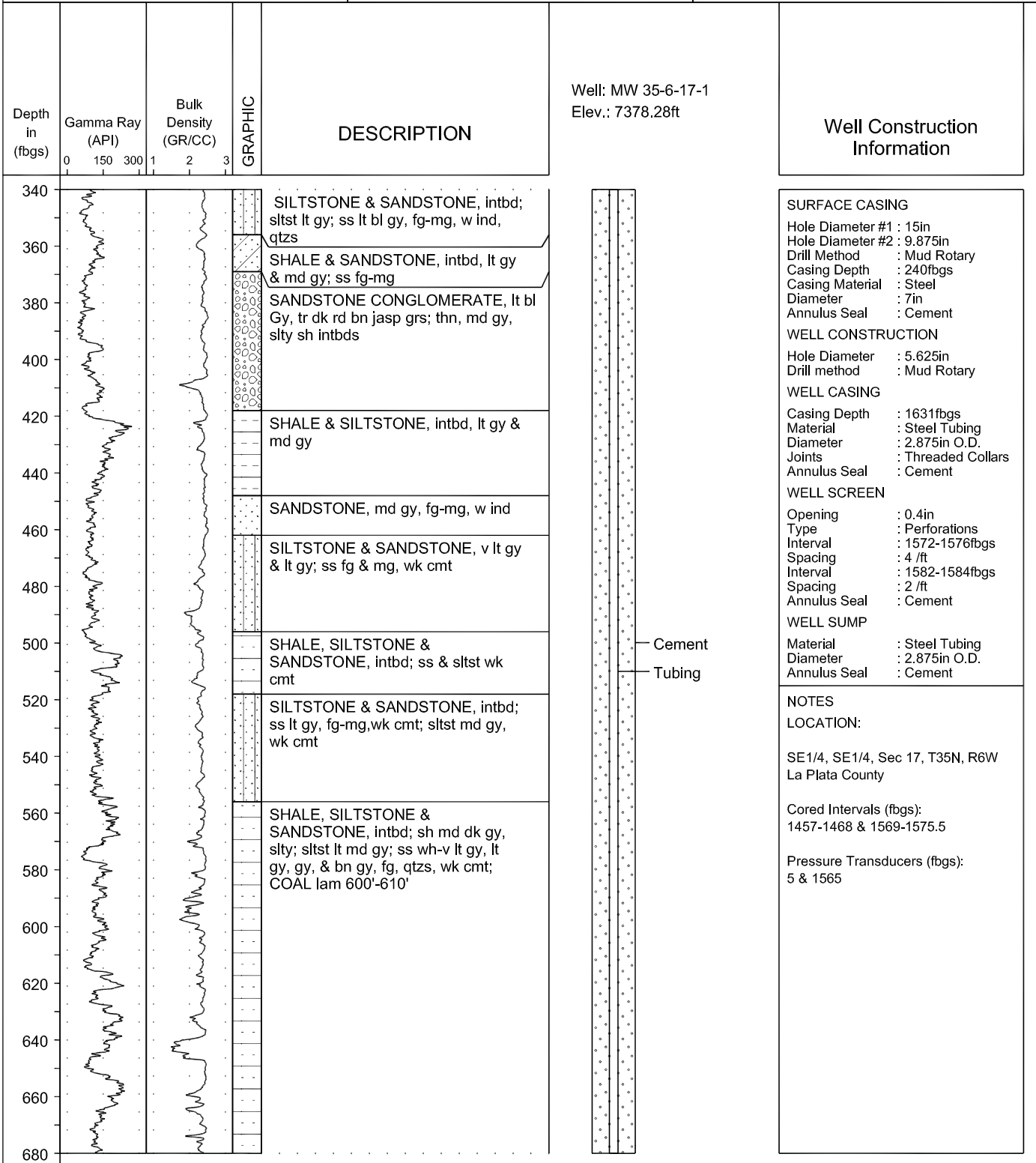
MW 35-6-17-1

(Page 2 of 5)

TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2248.9m, 7378.28ft
 Northing Coord. : 4130475.98m
 Easting Coord. : 274373.72

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BEAVER CREEK RANCH





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 3/15/02
 Date Completed : 4/4/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 1645fbgs

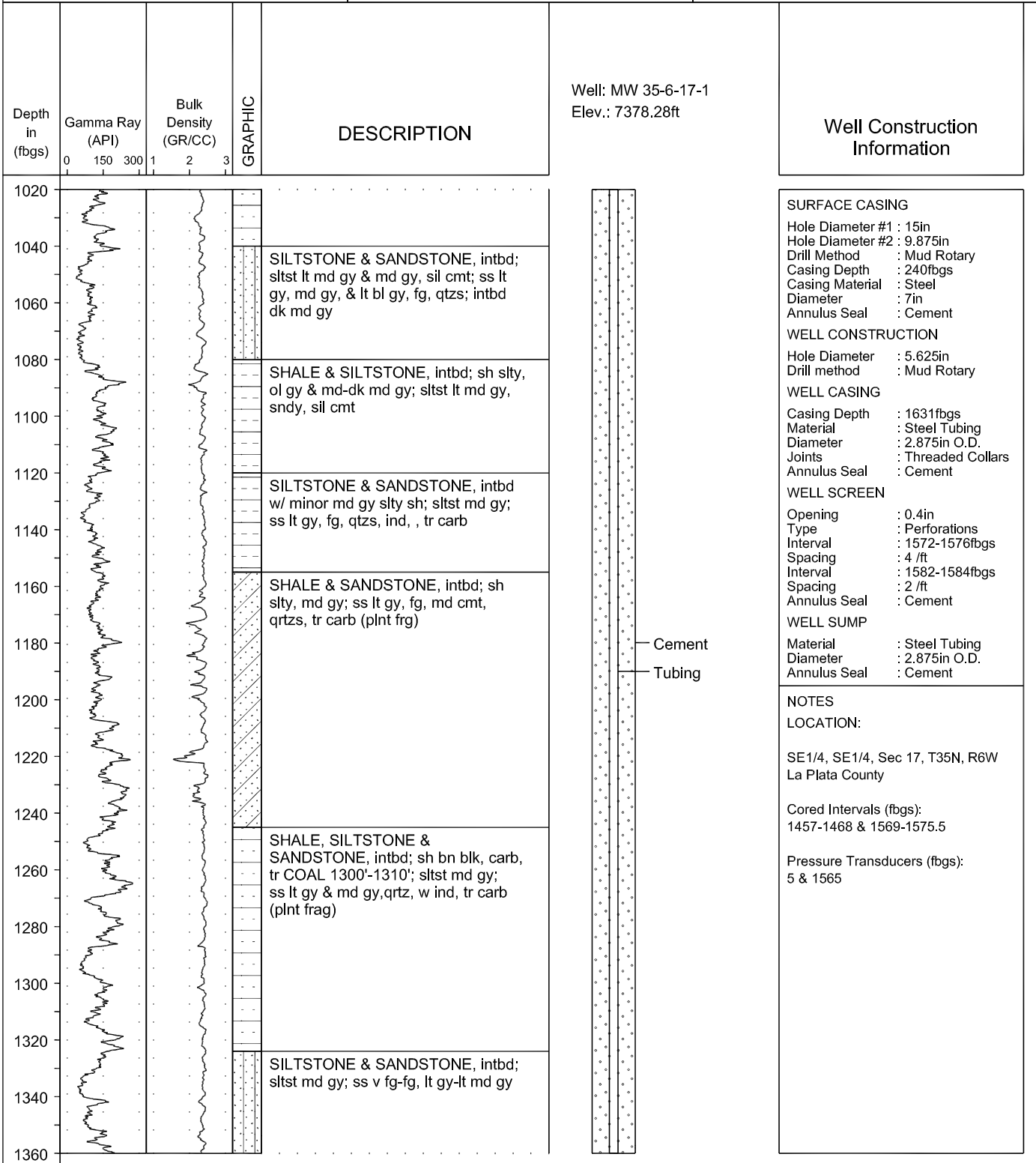
MW 35-6-17-1

(Page 4 of 5)

TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2248.9m, 7378.28ft
 Northing Coord. : 4130475.98m
 Easting Coord. : 274373.72

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BEAVER CREEK RANCH





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 3/15/02
 Date Completed : 4/4/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 1645fbgs

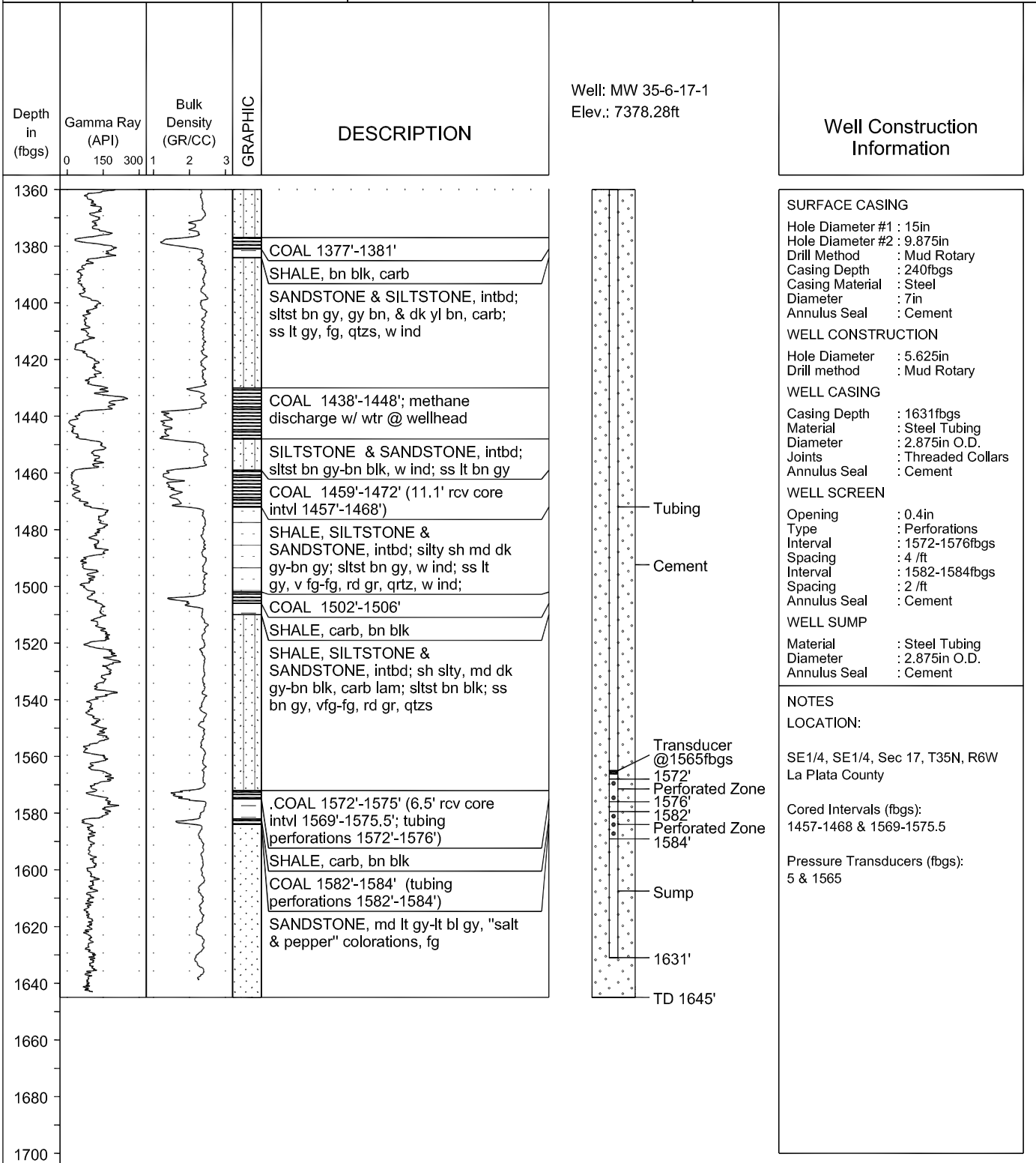
MW 35-6-17-1

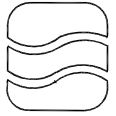
(Page 5 of 5)

TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2248.9m, 7378.28ft
 Northing Coord. : 4130475.98m
 Easting Coord. : 274373.72

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BEAVER CREEK RANCH





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/22/01
 Date Completed : 10/4/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 1550fbgs

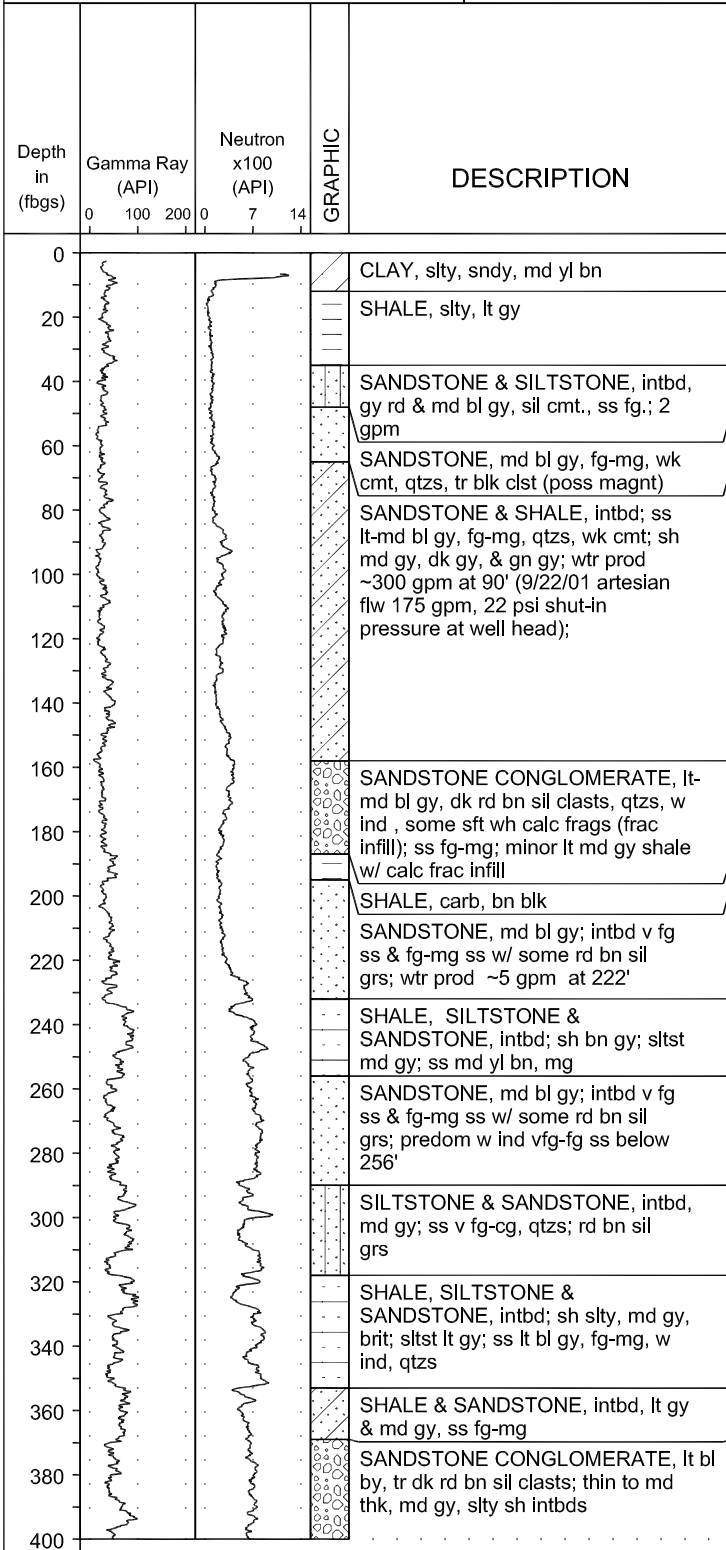
MW 35-6-17-2

(Page 1 of 4)

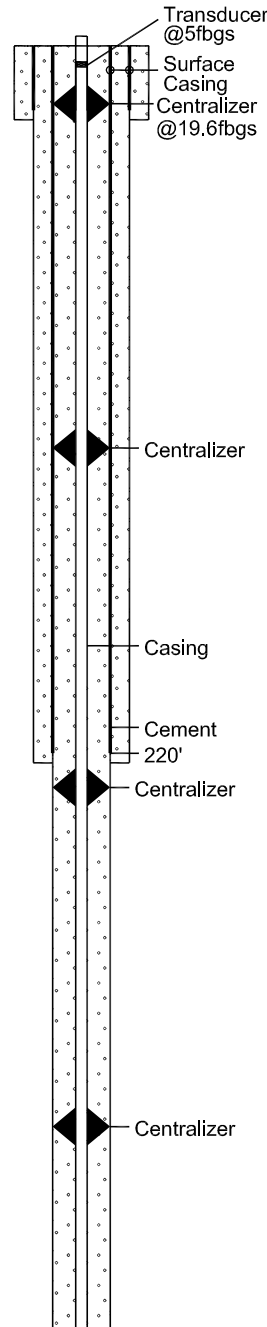
TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2249.87m, 7381.45ft
 Northing Coord. : 4130487.63m
 Easting Coord. : 274383.67m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BEAVER CREEK RANCH



Well: MW 35-6-17-2
Elev.: 7381.45ft



Well Construction Information

SURFACE CASING

Hole Diameter : 15in
 Drill Method : Air Rotary w/ Foam
 Casing Depth : 20fbgs
 Casing Material : CMP
 Diameter : 13in

INTERMEDIATE CASING

Hole Diameter : 9.875in
 Drill Method : Air Rotary w/ Foam
 Casing Depth : 220fbgs
 Casing Material : Steel
 Diameter : 7in
 Joints : Threaded

WELL CONSTRUCTION

Hole Diameter : 5.625in
 Drill method : Air Rotary w/ Foam

WELL CASING

Casing Depth : 1497fbgs
 Material : Galvanized Steel
 Diameter : 2in
 Joints : Threaded Collars

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Spacing : 2/ft
 Intervals : 1437-1449fbgs
 : 1458-1472fbgs

WELL SUMP

Material : Galvanized Steel
 Diameter : 2in

NOTES

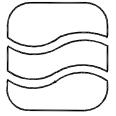
LOCATION:

SE1/4, SE1/4, Sec 17, T35N, R6W
 La Plata County

Geophysical logs for 2" dia. cased hole

Annulus Seal: Cement for all

Pressure Transducers (fbgs):
 5 & 1420



**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 9/22/01
 Date Completed : 10/4/01
 Well Type : Monitoring
 Date Surveyed : 12/01
 Bore Depth : 1550fbgs

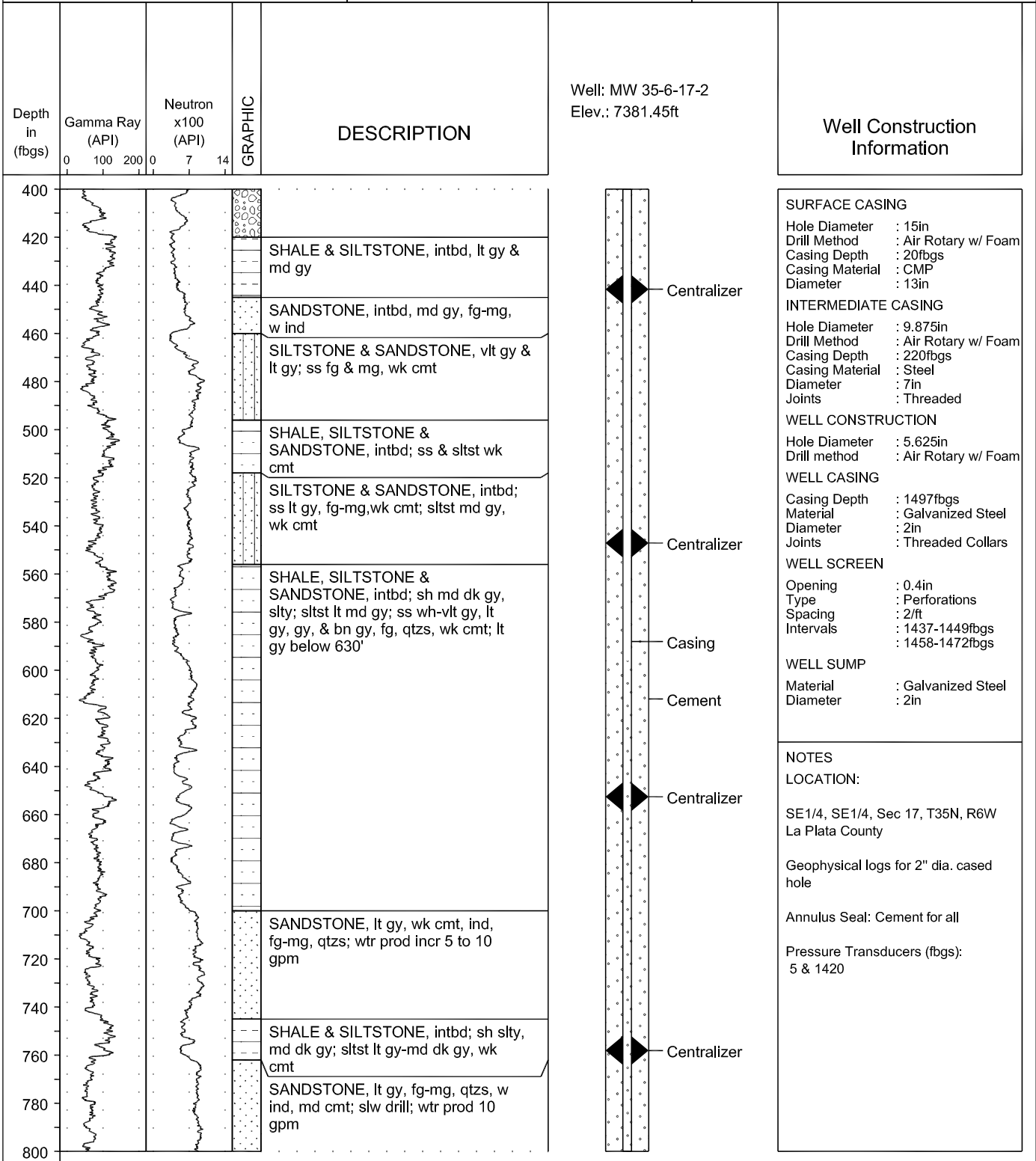
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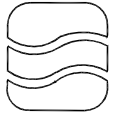
(Page 2 of 4)

TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2249.87m, 7381.45ft
 Northing Coord. : 4130487.63m
 Easting Coord. : 274383.67m

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 Date Surveyed : 12/01
 Bore Depth : 1550fbgs

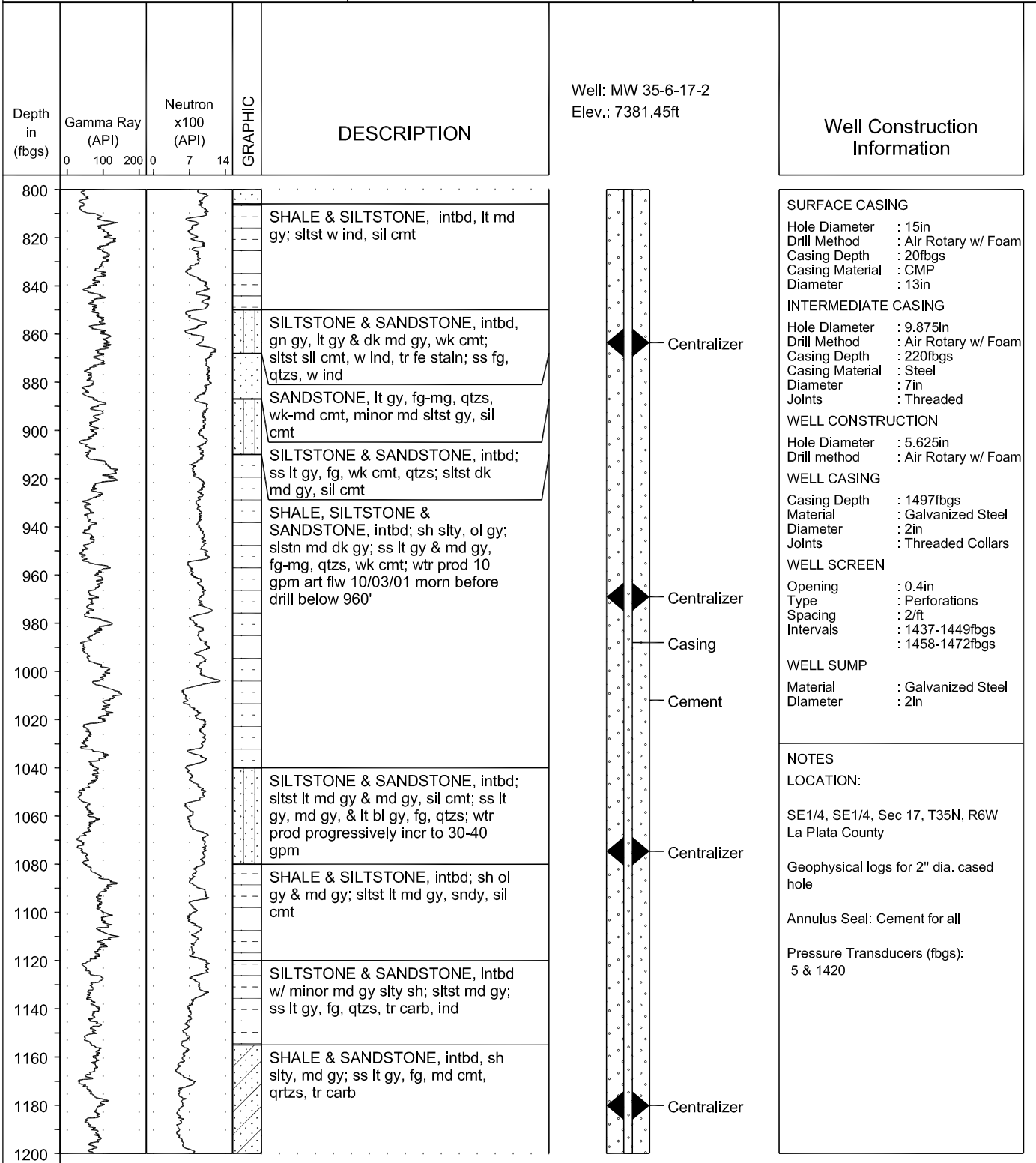
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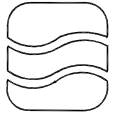
(Page 3 of 4)

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 Date Surveyed : 12/01
 Bore Depth : 1550fbgs

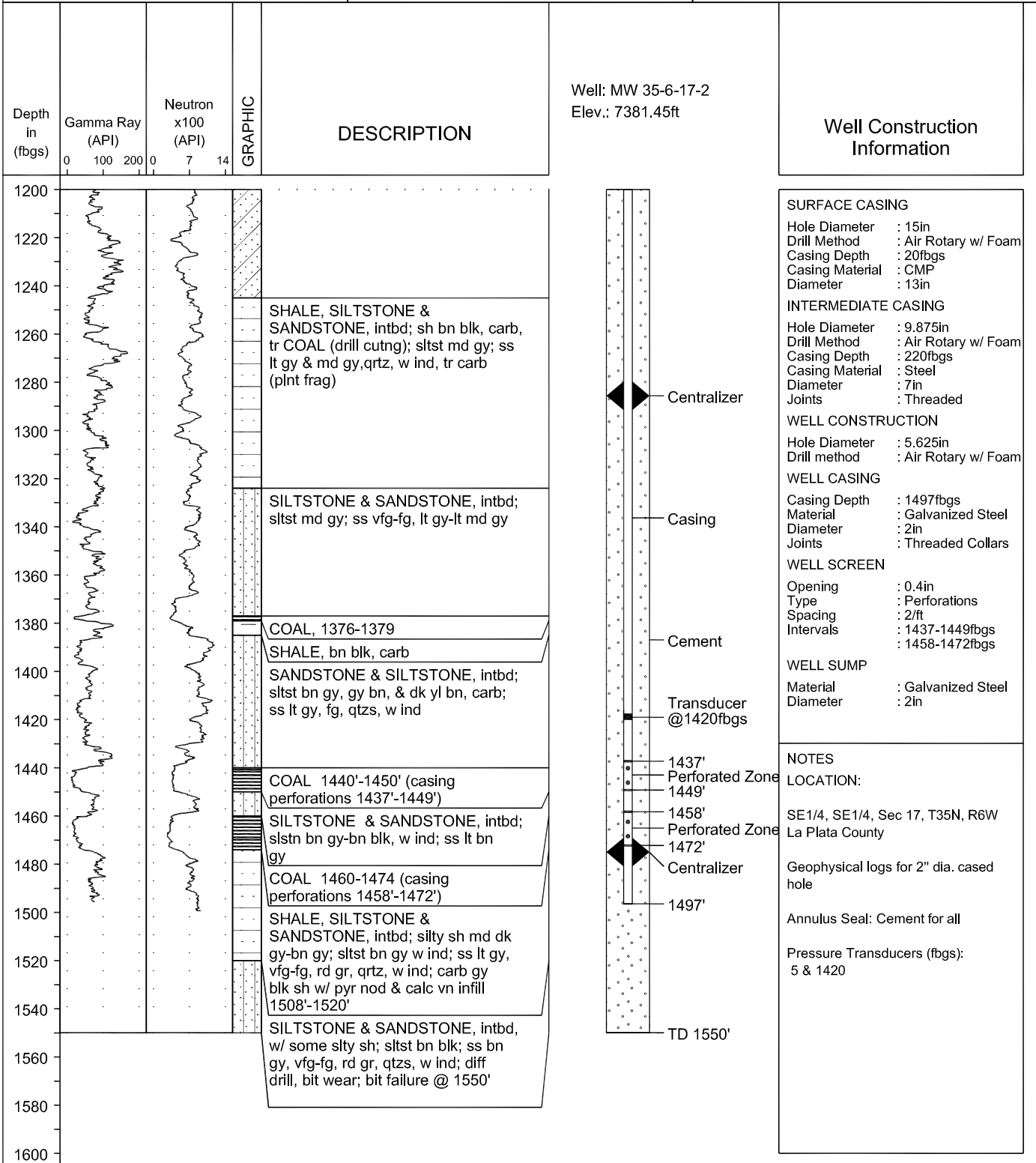
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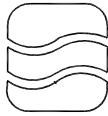
(Page 4 of 4)

TOC Elev. (m, AMSL) : N/A
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 Northing Coord. : 4130487.63m
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**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: BEAVER CREEK RANCH





**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 5/5/02
 Date Completed : 5/7/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 627fbgs

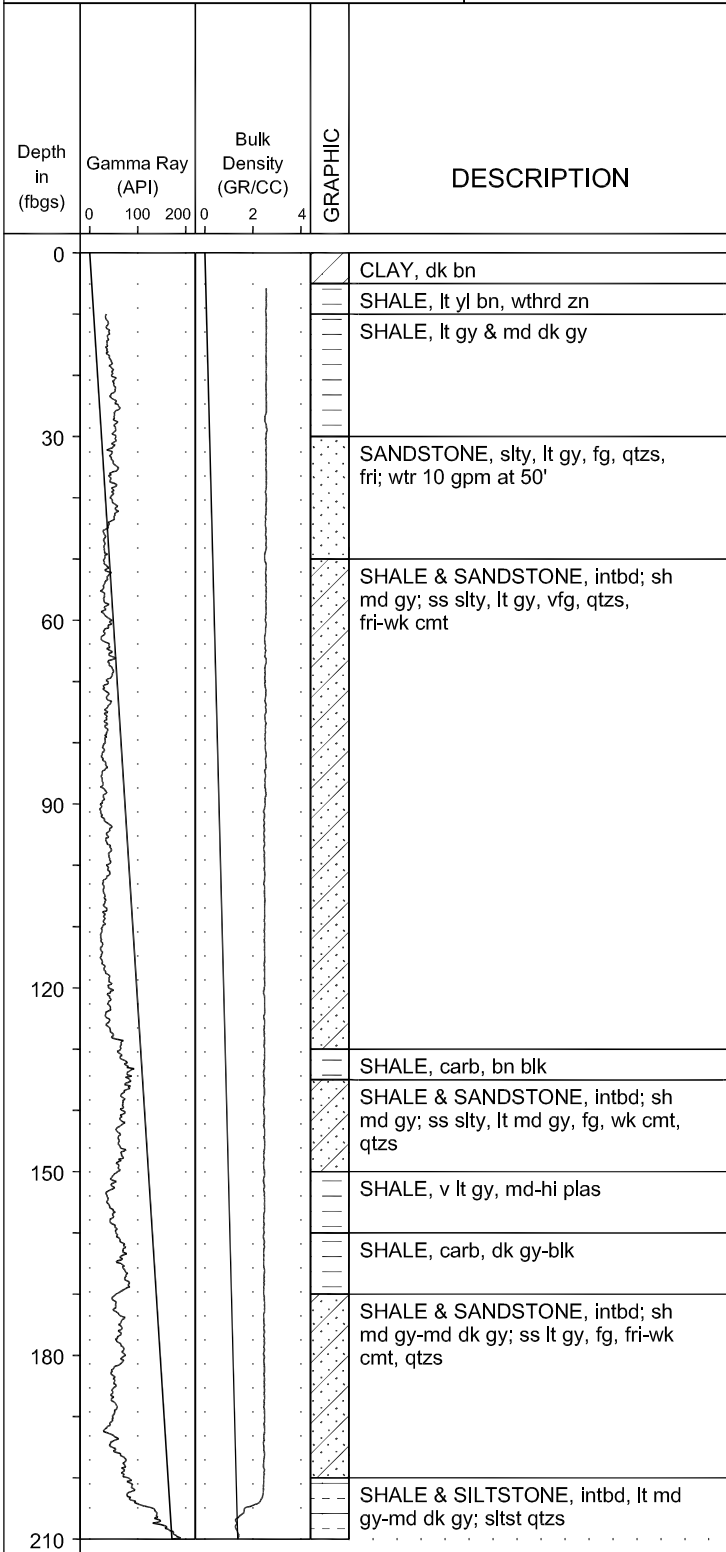
MW 35-6-13-1

(Page 1 of 3)

TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2352.18m, 7717.12ft
 Northing Coord. : 4130738.94m
 Easting Coord. : 279795.72m

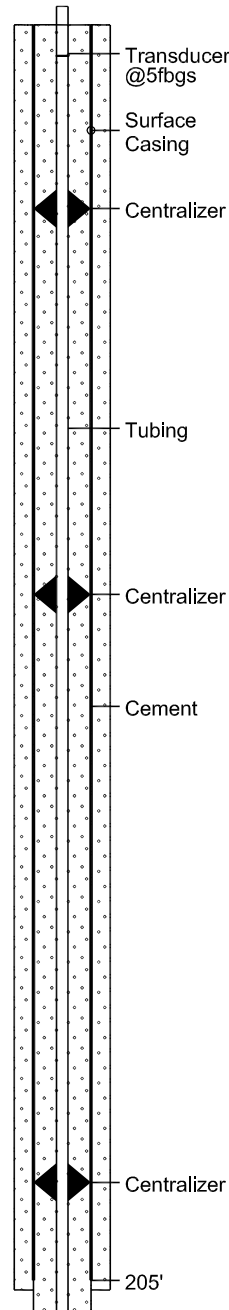
**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: SHAMROCK MINES



Well: MW 35-6-13-1
Elev.: 7717.12ft

Well Construction Information



SURFACE CASING

Hole Diameter #1 : 15in (0-16')
 Hole Diameter #2 : 9.875in (16'-208')
 Drill Method : Air Rotary w/ Foam
 Casing Depth : 205fbgs
 Casing Material : Steel
 Diameter : 7in
 Annulus Seal : Cement

WELL CONSTRUCTION

Depth : 627fbgs
 Hole Diameter : 6.25in
 Drill method : Air Rotary w/ Foam

WELL CASING

Depth : 606fbgs
 Material : Steel Tubing
 Diameter : 2.375in O.D.
 Joints : Threaded Collars
 Annulus Seal : Cement

WELL SCREEN

Opening : 0.4in
 Type : Perforations
 Interval Spacing : 2/ft
 Intervals : 507-511fbgs
 : 517-533fbgs
 : 539-562fbgs
 Annulus Seal : Cement

WELL SUMP

Material : Steel Tubing
 Diameter : 2.375in O.D.
 Annulus Seal : Cement

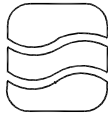
NOTES

LOCATION:

NW1/4, SW1/4, Sec13, T35N, R6W
 La Plata County

Cored Intervals: None

Pressure Transducers (fbgs):
 5 & 500



**Applied
Hydrology
Associates, Inc.**

Drilling Co. : Sharpe Drilling
 Driller : Lyle Sharpe
 Geologist : D. Baldwin, E. Schneider
 Date Started : 5/5/02
 Date Completed : 5/7/02
 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 627fbs

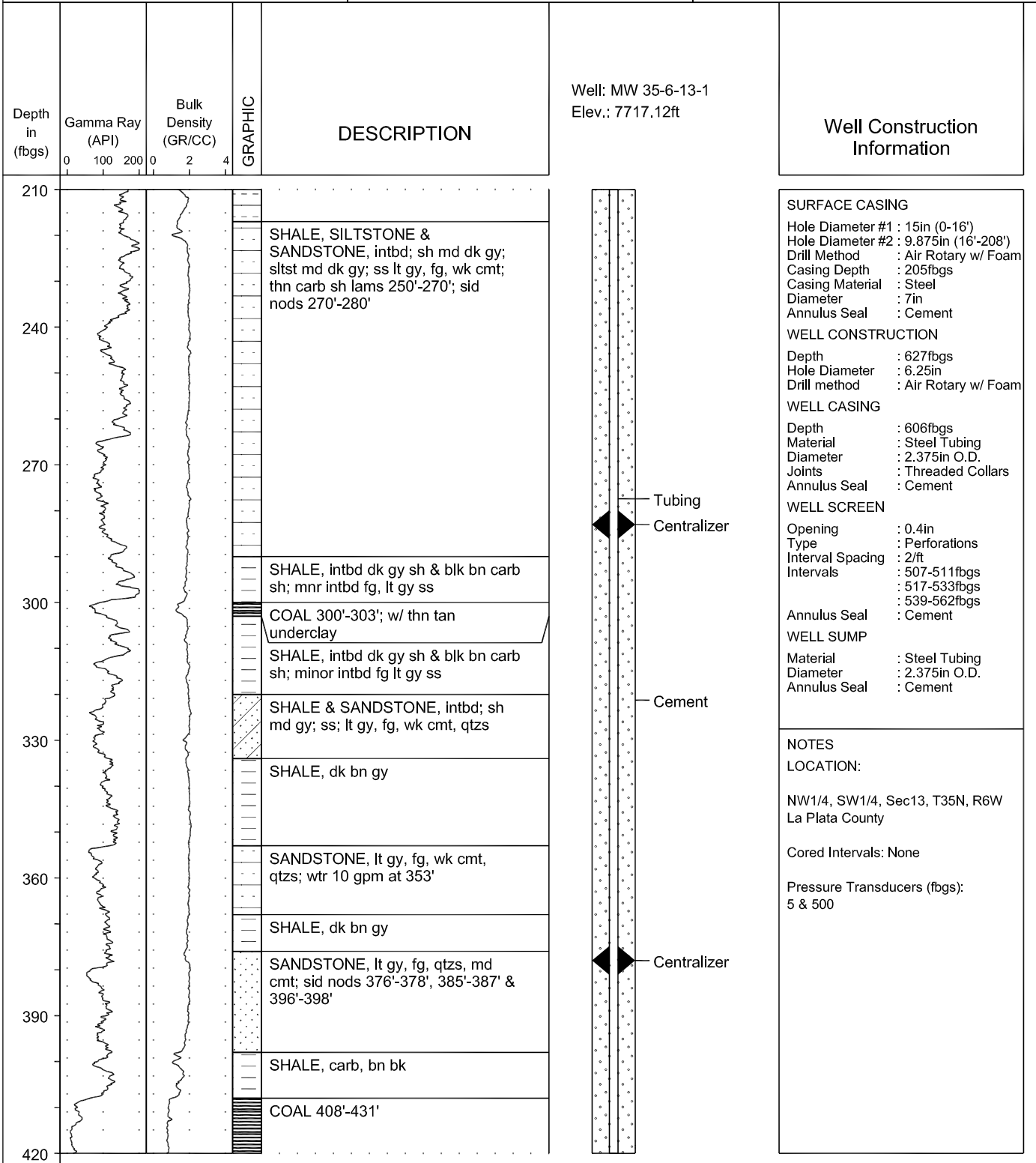
MW 35-6-13-1

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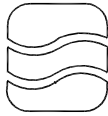
TOC Elev. (m, AMSL) : N/A
 Top of Pad Elev. : 2352.18m, 7717.12ft
 Northing Coord. : 4130738.94m
 Easting Coord. : 279795.72m

**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: SHAMROCK MINES



NOTES
 LOCATION:
 NW1/4, SW1/4, Sec13, T35N, R6W
 La Plata County
 Cored Intervals: None
 Pressure Transducers (fbs):
 5 & 500



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 Well Type : Monitoring
 Date Surveyed : 06/02
 Bore Depth : 627fbs

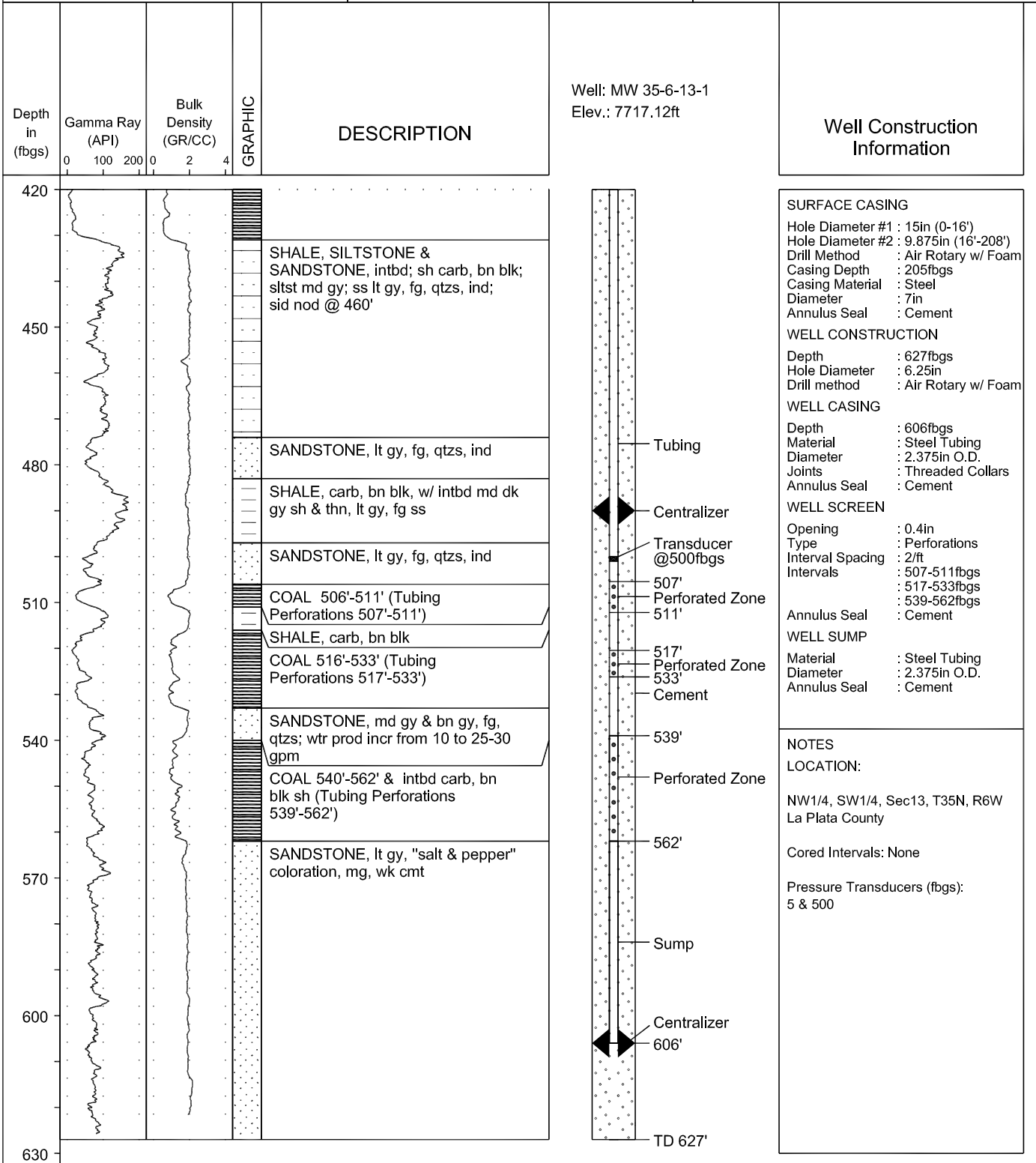
MW 35-6-13-1

(Page 3 of 3)

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**3M PROJECT
COGCC
MONITORING WELL CONSTRUCTION**

AREA: SHAMROCK MINES



APPENDIX B

Installation Photographs

- Photo 1 Basin Creek MW 34-9-7-1 wellhead assembly
- Photo 2 Basin Creek MW 34-9-7-1 cage
- Photo 3 Beaver Creek Ranch MW 35-6-17-2 wellhead assembly
- Photo 4 Basin Creek telemetry shed
- Photo 5 Hermit data logger and telemetry (temporary)
- Photo 6 Power and telemetry detail
- Photo 7 Hermit logger and telemetry at South Fork Texas Creek (final)

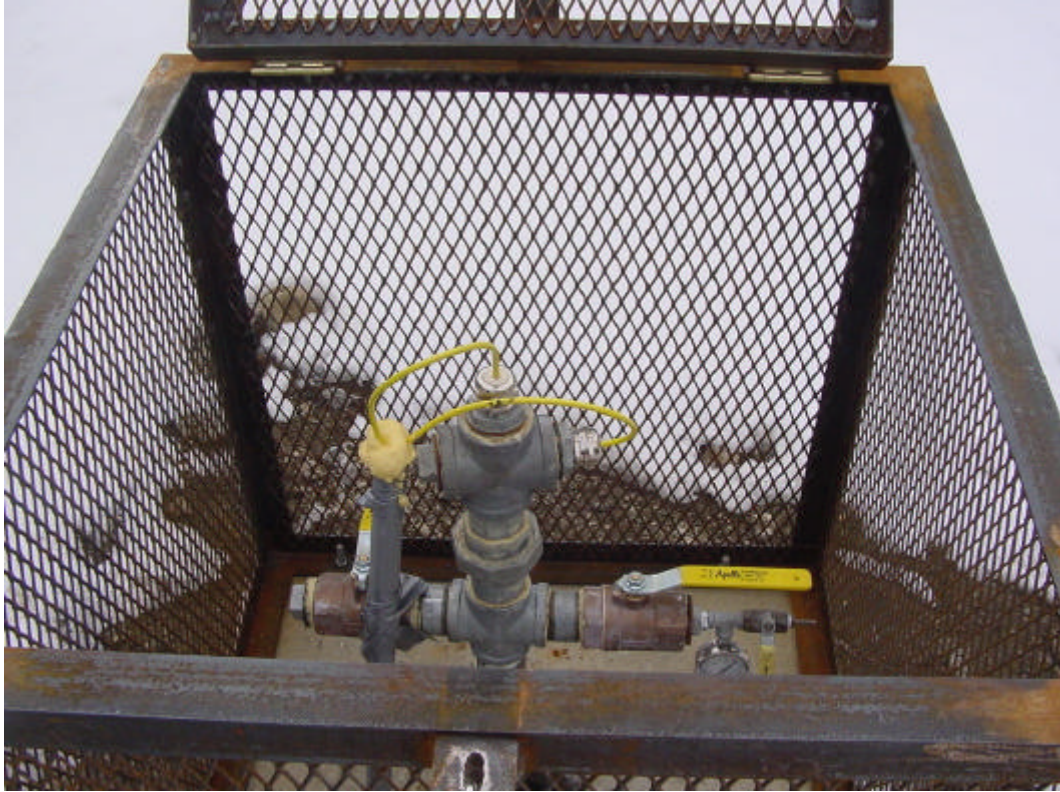


Photo 1. Basin Creek MW 34-9-7-1 wellhead assembly.



Photo 2. Basin Creek MW 34-9-7-1 cage.



Photo 3. Beaver Creek Ranch MW 35-6-17-2 wellhead assembly.



Photo 4. Basin Creek telemetry shed.



Photo 5. Hermit data logger and telemetry (temporary).

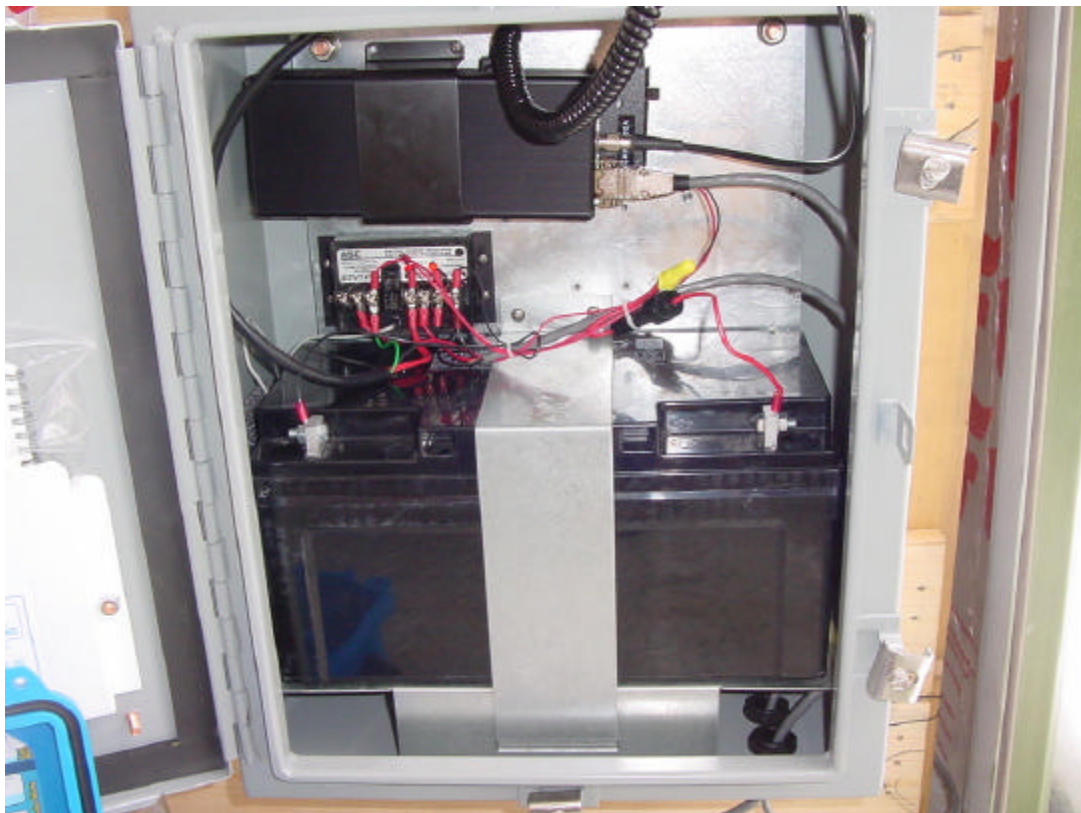


Photo 6. Power and telemetry detail.



Photo 7. Hermit logger and telemetry at South Fork of Texas Creek (final).

APPENDIX C

Operations Manuals

- C-1 Downloading Instructions
- C-2 Win-Situ 2000 Operator's Manual
- C-3 Hermit 3000 Data Logger Operator's Manual
- C-4 In-Situ, Inc. Instructions, Telemetry Systems
- C-5 Motorola Cellular Telephone Modem Carry and Mobile Installation Manual
- C-6 Motorola Cellular Telephone Modem Quick Reference Card
- C-7 Motorola Cellular Telephone Modem Operational Guide
- C-8 Cellular Mobile Telephone User Guide and Programming Instructions
- C-9 General Installation Guide for Siemens Solar Electric Modules
- C-10 Cable Diagram for MW 35-6-17-1 and MW 35-6-17-2