



Azimuths to Grid North
 True North: 0.27°
 Magnetic North: -8.54°
 Magnetic Field
 Strength: 52100.0snT
 Dip Angle: 66.41°
 Date: 12/18/2014
 Model: USER DEFINED

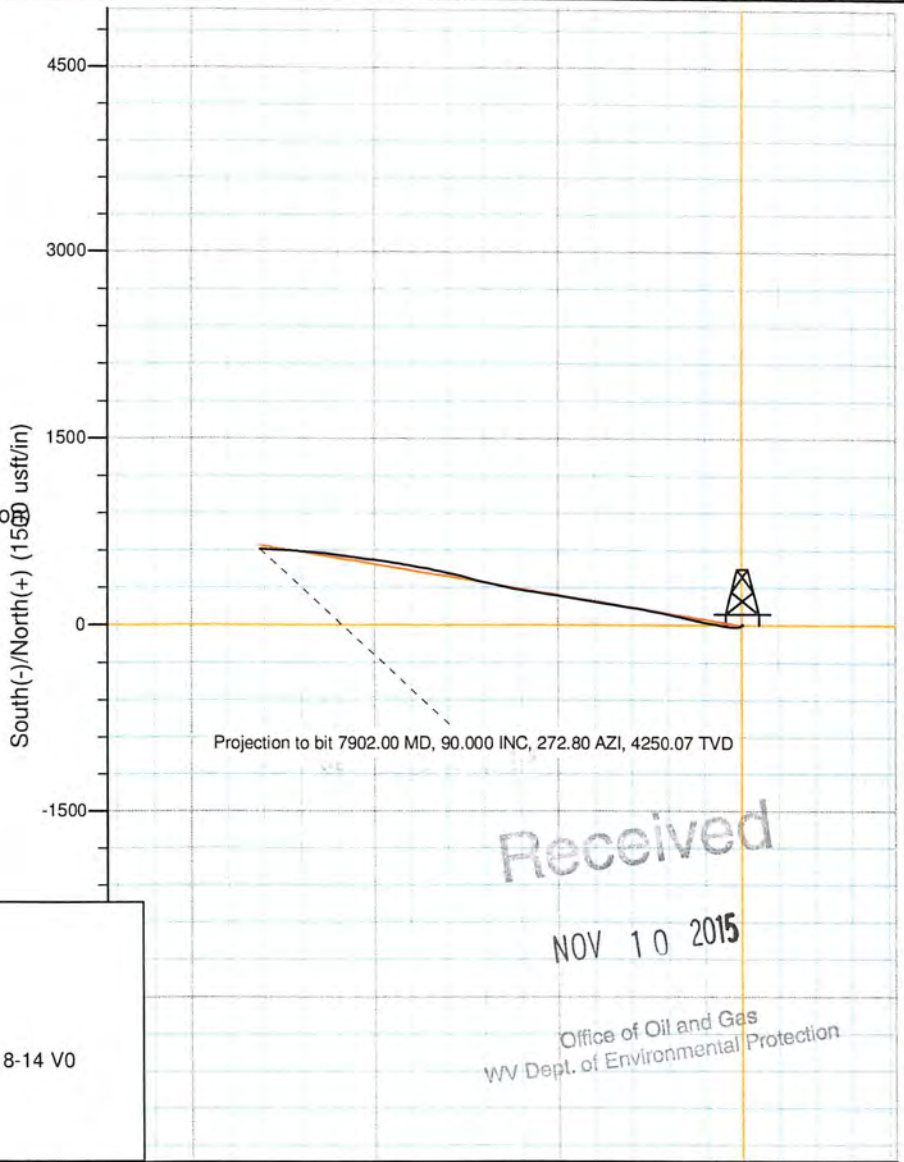
PROJECT DETAILS: Roane County, WV

Geodetic System: US State Plane 1927 (Exact solution)
 Datum: NAD 1927 (NADCON CONUS)
 Ellipsoid: Clarke 1866
 Zone: West Virginia South 4702
 System Datum: Mean Sea Level



LEGEND

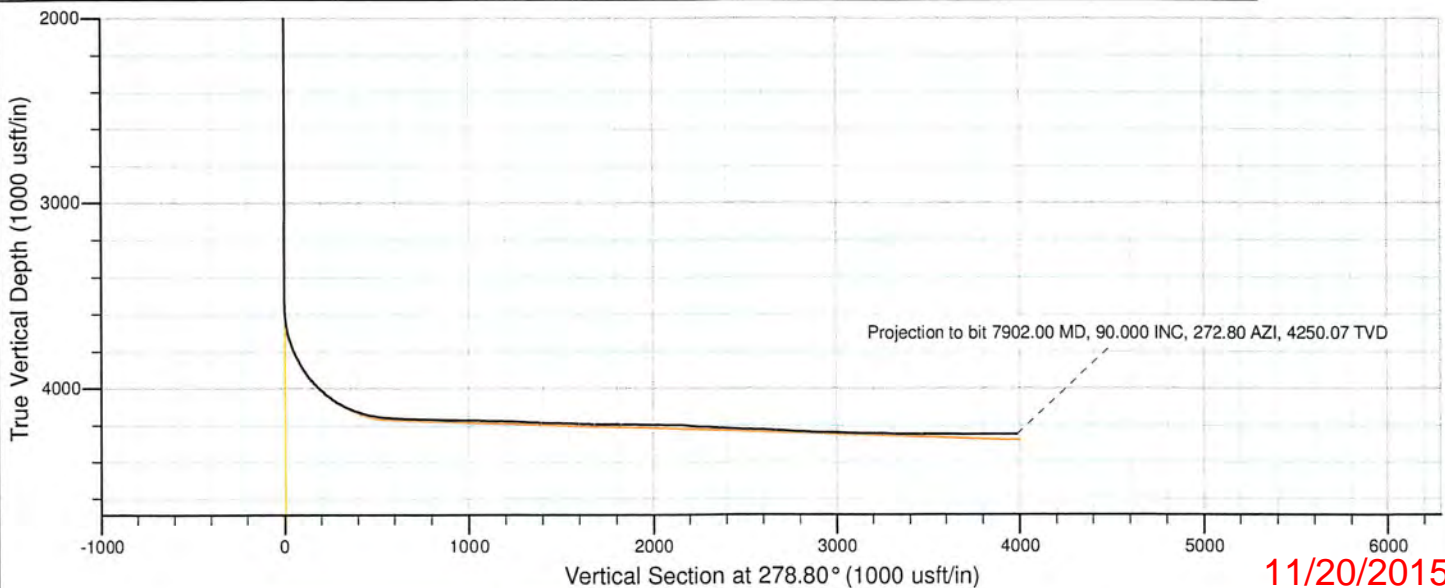
- HR-505, HR-505 - Orig Hole, Plan #1 - 12-18-14 V0
- HR-505 - As Drilled



Received
 NOV 10 2015
 Office of Oil and Gas
 WV Dept. of Environmental Protection

WELL DETAILS: HR-505

+N/-S	+E/-W	Northing	Ground Level:	712.00	Longitude
0.00	0.00	697295.8600	Easting	1876004.3000	Latitude
					38° 54' 50.741 N
					81° 26' 8.693 W



11/20/2015



Hardrock Exploration

Roane County, WV

HR-505

HR-505

HR-505 - Orig Hole

Design: HR-505 - As Drilled

Standard Survey Report

07 January, 2015

Received

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Office of Oil and Gas
WV Dept. of Environmental Protection



Directional Drilling Contractors

AN ARCHER COMPANY

11/20/2015



Directional Drilling Contractors
Survey Report



Company:	Hardrock Exploration	Local Co-ordinate Reference:	Well HR-505
Project:	Roane County, WV	TVD Reference:	GL @ 712.00usft (Original Well Elev)
Site:	HR-505	MD Reference:	GL @ 712.00usft (Original Well Elev)
Well:	HR-505	North Reference:	Grid
Wellbore:	HR-505 - Orig Hole	Survey Calculation Method:	Minimum Curvature
Design:	HR-505 - As Drilled	Database:	EDM 5000.1 Single User Db

Project	Roane County, WV		
Map System:	US State Plane 1927 (Exact solution)	System Datum:	Mean Sea Level
Geo Datum:	NAD 1927 (NADCON CONUS)		
Map Zone:	West Virginia South 4702		

Site	HR-505				
Site Position:		Northing:	697,295.8600 usft	Latitude:	38° 54' 50.741 N
From:	Map	Easting:	1,876,004.3000 usft	Longitude:	81° 26' 8.693 W
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	-0.27 °

Well	HR-505					
Well Position	+N/-S	0.00 usft	Northing:	697,295.8600 usft	Latitude:	38° 54' 50.741 N
	+E/-W	0.00 usft	Easting:	1,876,004.3000 usft	Longitude:	81° 26' 8.693 W
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	712.00 usft

Wellbore	HR-505 - Orig Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	User Defined	12/18/14	-8.81	66.41	52,100

Design	HR-505 - As Drilled				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.00	0.00	0.00		278.80

Survey Program	Date 01/07/15				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	3,510.00	Survey #1 (HR-505 - Orig Hole)	GyroFlex		
3,518.00	7,902.00	MWD (HR-505 - Orig Hole)	MWD+HDGM	OWSG MWD + HDGM	

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.00	0.490	346.70	100.00	0.42	-0.10	0.16	0.49	0.49	0.00
200.00	0.730	340.30	199.99	1.43	-0.41	0.63	0.25	0.24	-6.40
300.00	0.430	327.80	299.99	2.35	-0.83	1.18	0.32	-0.30	-12.50
400.00	0.650	347.70	399.98	3.22	-1.15	1.63	0.29	0.22	19.90
500.00	0.300	23.00	499.98	4.02	-1.17	1.77	0.44	-0.35	35.30
600.00	0.920	353.60	599.97	5.06	-1.15	1.91	0.67	0.62	-29.40
700.00	0.510	13.10	699.97	6.29	-1.14	2.09	0.47	-0.41	19.50
800.00	0.680	342.40	799.96	7.29	-1.22	2.32	0.36	0.17	-30.70
900.00	0.560	20.80	899.96	8.31	-1.23	2.48	0.42	-0.12	38.40

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NOV 10 2015

Office of Oil and Gas
WV Dept. of Environmental Protection



Directional Drilling Contractors



Directional Drilling Contractors
AN MCDERMOTT COMPANY

Received Survey Report

NOV 10 2015

Company: Hardrock Exploration
Project: Roane County, WV
Site: HR-505
Well: HR-505
Wellbore: HR-505 - Orig Hole
Design: HR-505 - As Drilled

Local Co-ordinate Reference: Well HR-505
TVD Reference: GL @ 712.00usft (Original Well Elev)
MD Reference: GL @ 712.00usft (Original Well Elev)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: EDM 5000.1 Single User Db

Office of Oil and Gas
WV Dept. of Environmental

Survey

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
1,000.00	0.370	340.40	999.95	9.07	-1.16	2.53	0.37	-0.19	-40.40
1,100.00	0.210	167.10	1,099.95	9.19	-1.23	2.62	0.58	-0.16	-173.30
1,200.00	0.440	173.00	1,199.95	8.63	-1.14	2.45	0.23	0.23	5.90
1,300.00	0.700	161.70	1,299.95	7.67	-0.90	2.07	0.28	0.26	-11.30
1,400.00	0.650	160.20	1,399.94	6.56	-0.52	1.52	0.05	-0.05	-1.50
1,500.00	0.150	126.90	1,499.94	5.95	-0.22	1.13	0.53	-0.50	-33.30
1,600.00	0.440	183.40	1,599.93	5.49	-0.14	0.98	0.38	0.29	56.50
1,700.00	0.180	70.60	1,699.93	5.15	-0.01	0.80	0.54	-0.26	-112.80
1,800.00	0.290	75.70	1,799.93	5.27	0.38	0.43	0.11	0.11	5.10
1,900.00	0.260	47.90	1,899.93	5.48	0.79	0.06	0.14	-0.03	-27.80
2,000.00	0.440	74.50	1,999.93	5.74	1.33	-0.44	0.24	0.18	26.60
2,100.00	0.430	47.60	2,099.93	6.09	1.98	-1.02	0.20	-0.01	-26.90
2,200.00	0.190	341.40	2,199.93	6.50	2.20	-1.18	0.39	-0.24	-66.20
2,300.00	0.180	258.80	2,299.93	6.63	2.00	-0.96	0.24	-0.01	-82.60
2,400.00	0.210	221.80	2,399.92	6.46	1.72	-0.71	0.13	0.03	-37.00
2,500.00	0.260	101.10	2,499.92	6.28	1.82	-0.84	0.41	0.05	-120.70
2,600.00	0.320	41.00	2,599.92	6.45	2.23	-1.21	0.30	0.06	-60.10
2,700.00	0.270	57.60	2,699.92	6.79	2.61	-1.54	0.10	-0.05	16.60
2,800.00	0.200	166.80	2,799.92	6.74	2.85	-1.78	0.39	-0.07	109.20
2,900.00	0.280	319.10	2,899.92	6.76	2.73	-1.66	0.47	0.08	152.30
3,000.00	0.250	178.40	2,999.92	6.73	2.57	-1.51	0.50	-0.03	-140.70
3,100.00	0.230	70.40	3,099.92	6.57	2.77	-1.73	0.39	-0.02	-108.00
3,200.00	0.260	89.60	3,199.92	6.64	3.18	-2.13	0.09	0.03	19.20
3,300.00	0.130	283.60	3,299.92	6.67	3.30	-2.24	0.39	-0.13	-166.00
3,400.00	0.380	197.10	3,399.92	6.38	3.09	-2.08	0.39	0.25	-86.50
3,510.00	0.480	89.20	3,509.92	6.04	3.45	-2.48	0.63	0.09	-98.09
3,518.00	0.500	191.50	3,517.92	6.01	3.47	-2.51	9.54	0.25	1,278.75
3,549.00	3.200	237.20	3,548.90	5.40	2.72	-1.86	9.27	8.71	147.42
3,612.00	8.500	240.90	3,611.55	2.19	-2.83	3.13	8.43	8.41	5.87
3,644.00	9.900	235.70	3,643.14	-0.52	-7.17	7.01	5.08	4.38	-16.25
3,706.00	15.300	247.10	3,703.63	-6.71	-19.12	17.87	9.55	8.71	18.39
3,769.00	21.700	261.40	3,763.37	-11.69	-38.32	36.08	12.38	10.16	22.70
3,832.00	27.300	269.40	3,820.69	-13.59	-64.31	61.48	10.31	8.89	12.70
3,864.00	28.400	274.10	3,848.99	-13.12	-79.24	76.30	7.67	3.44	14.69
3,895.00	30.200	276.80	3,876.02	-11.67	-94.34	91.44	7.20	5.81	8.71
3,927.00	33.300	277.90	3,903.23	-9.51	-111.04	108.27	9.85	9.69	3.44
3,959.00	36.500	278.80	3,929.47	-6.84	-129.15	126.58	10.13	10.00	2.81
3,991.00	40.100	279.40	3,954.58	-3.70	-148.73	146.41	11.31	11.25	1.88
4,022.00	42.900	280.30	3,977.80	-0.19	-168.96	166.94	9.23	9.03	2.90
4,054.00	46.100	280.60	4,000.62	3.88	-191.02	189.36	10.02	10.00	0.94
4,085.00	48.500	280.20	4,021.64	7.99	-213.42	212.13	7.80	7.74	-1.29
4,117.00	51.700	280.50	4,042.16	12.41	-237.57	236.67	10.03	10.00	0.94
4,180.00	58.800	281.80	4,078.05	22.43	-288.32	288.35	11.40	11.27	2.06



Directional Drilling Contractors
Survey Report



Company: Hardrock Exploration
Project: Roane County, WV
Site: HR-505
Well: HR-505
Wellbore: HR-505 - Orig Hole
Design: HR-505 - As Drilled

NOV 10 2015
Office of Oil and Gas
WV Dept of Environmental Protection

Local Co-ordinate Reference: Well HR-505
TVD Reference: GL @ 712.00usft (Original Well Elev)
NGS Reference: GL @ 712.00usft (Original Well Elev)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: EDM 5000.1 Single User Db

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
4,211.00	62.400	282.40	4,093.27	28.10	-314.72	315.31	11.73	11.61	1.94
4,243.00	65.700	281.50	4,107.27	34.05	-342.87	344.04	10.62	10.31	-2.81
4,275.00	68.100	281.30	4,119.82	39.87	-371.72	373.44	7.52	7.50	-0.63
4,338.00	74.900	282.00	4,139.80	51.93	-430.20	433.08	10.84	10.79	1.11
4,370.00	78.300	281.80	4,147.22	58.35	-460.65	464.15	10.64	10.63	-0.63
4,402.00	81.500	283.10	4,152.83	65.14	-491.41	495.59	10.77	10.00	4.06
4,465.00	85.000	283.00	4,160.23	79.27	-552.35	557.97	5.56	5.56	-0.16
4,527.00	86.500	281.00	4,164.83	92.12	-612.82	619.70	4.03	2.42	-3.23
4,559.00	87.400	280.10	4,166.53	97.97	-644.23	651.64	3.97	2.81	-2.81
4,623.00	88.500	279.80	4,168.82	109.02	-707.23	715.58	1.78	1.72	-0.47
4,686.00	88.400	280.00	4,170.52	119.85	-769.27	778.55	0.35	-0.16	0.32
4,717.00	87.900	279.60	4,171.52	125.12	-799.80	809.53	2.07	-1.61	-1.29
4,781.00	88.800	279.30	4,173.37	135.63	-862.91	873.50	1.48	1.41	-0.47
4,844.00	89.100	279.80	4,174.52	146.08	-925.02	936.48	0.93	0.48	0.79
4,906.00	89.200	278.40	4,175.44	155.88	-986.23	998.47	2.26	0.16	-2.26
4,969.00	88.500	278.40	4,176.70	165.08	-1,048.54	1,061.46	1.11	-1.11	0.00
5,032.00	88.800	278.00	4,178.19	174.07	-1,110.88	1,124.44	0.79	0.48	-0.63
5,095.00	88.400	279.30	4,179.73	183.54	-1,173.15	1,187.42	2.16	-0.63	2.06
5,159.00	88.600	280.20	4,181.40	194.37	-1,236.20	1,251.38	1.44	0.31	1.41
5,222.00	88.000	280.60	4,183.27	205.74	-1,298.14	1,314.33	1.14	-0.95	0.63
5,285.00	87.300	279.00	4,185.86	216.45	-1,360.16	1,377.27	2.77	-1.11	-2.54
5,348.00	88.500	279.20	4,188.16	226.41	-1,422.33	1,440.22	1.93	1.90	0.32
5,411.00	88.900	278.90	4,189.59	236.32	-1,484.53	1,503.21	0.79	0.63	-0.48
5,475.00	87.900	278.20	4,191.38	245.83	-1,547.79	1,567.18	1.91	-1.56	-1.09
5,507.00	88.200	277.70	4,192.47	250.25	-1,579.46	1,599.16	1.82	0.94	-1.56
5,569.00	87.900	277.90	4,194.58	258.66	-1,640.85	1,661.11	0.58	-0.48	0.32
5,664.00	89.800	279.10	4,196.49	272.70	-1,734.79	1,756.08	2.37	2.00	1.26
5,695.00	89.800	280.60	4,196.59	278.00	-1,765.33	1,787.08	4.84	0.00	4.84
5,758.00	88.600	280.10	4,197.47	289.32	-1,827.30	1,850.05	2.06	-1.90	-0.79
5,790.00	90.100	281.00	4,197.84	295.18	-1,858.75	1,882.03	5.47	4.69	2.81
5,853.00	88.800	280.40	4,198.44	306.88	-1,920.65	1,944.99	2.27	-2.06	-0.95
5,916.00	89.900	282.30	4,199.16	319.27	-1,982.41	2,007.92	3.48	1.75	3.02
5,961.00	89.000	282.70	4,199.59	329.01	-2,026.34	2,052.82	2.19	-2.00	0.89
6,012.00	89.800	283.40	4,200.12	340.53	-2,076.02	2,103.68	2.08	1.57	1.37
6,075.00	87.300	283.80	4,201.72	355.33	-2,137.23	2,166.44	4.02	-3.97	0.63
6,106.00	85.300	284.20	4,203.72	362.82	-2,167.25	2,197.24	6.58	-6.45	1.29
6,172.00	85.100	284.70	4,209.24	379.23	-2,230.93	2,262.69	0.81	-0.30	0.76
6,236.00	86.200	284.00	4,214.09	395.05	-2,292.76	2,326.21	2.04	1.72	-1.09
6,299.00	86.700	283.30	4,218.00	409.88	-2,353.86	2,388.86	1.36	0.79	-1.11
6,329.00	87.300	282.30	4,219.57	416.52	-2,383.07	2,418.75	3.88	2.00	-3.33
6,361.00	87.500	281.10	4,221.02	423.00	-2,414.38	2,450.67	3.80	0.63	-3.75
6,392.00	88.200	282.10	4,222.18	429.23	-2,444.72	2,481.61	3.94	2.26	3.23
6,455.00	88.500	281.70	4,223.99	442.22	-2,506.34	2,544.49	0.79	0.48	-0.63



Directional Drilling Contractors

Survey Report



Received
NOV 10 2015

Company:	Hardrock Exploration	Local Co-ordinate Reference:	Well HR-505
Project:	Roane County, WV	TVD Reference:	GL @ 712.00usft (Original Well Elev)
Site:	HR-505	MD Reference:	GL @ 712.00usft (Original Well Elev)
Well:	HR-505	North Reference:	Grid
Wellbore:	HR-505 - Orig Hole	Survey Calculation Method:	Minimum Curvature
Design:	HR-505 - As Drilled	Database:	EDM 5000.1 Single User Db

Office of Oil and Gas
WV Dept. of Environmental Protection

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
6,486.00	87.600	281.10	4,225.05	448.34	-2,536.71	2,575.44	3.49	-2.90	-1.94
6,518.00	88.000	280.90	4,226.28	454.44	-2,568.10	2,607.40	1.40	1.25	-0.63
6,581.00	86.900	280.20	4,229.08	465.97	-2,629.97	2,670.30	2.07	-1.75	-1.11
6,676.00	88.300	279.60	4,233.06	482.28	-2,723.47	2,765.20	1.60	1.47	-0.63
6,740.00	87.400	278.00	4,235.46	492.07	-2,786.67	2,829.15	2.87	-1.41	-2.50
6,803.00	87.700	278.50	4,238.15	501.10	-2,848.96	2,892.09	0.92	0.48	0.79
6,866.00	88.600	277.90	4,240.19	510.08	-2,911.29	2,955.05	1.72	1.43	-0.95
6,929.00	88.700	277.90	4,241.67	518.74	-2,973.67	3,018.03	0.16	0.16	0.00
6,960.00	87.900	278.40	4,242.59	523.13	-3,004.34	3,049.01	3.04	-2.58	1.61
7,024.00	88.400	277.70	4,244.66	532.09	-3,067.88	3,112.97	1.34	0.78	-1.09
7,088.00	89.800	277.60	4,245.66	540.61	-3,131.10	3,176.95	2.19	2.19	-0.16
7,151.00	89.400	277.20	4,246.10	548.72	-3,193.57	3,239.93	0.90	-0.63	-0.63
7,183.00	88.100	277.00	4,246.80	552.67	-3,225.32	3,271.91	4.11	-4.06	-0.63
7,214.00	88.200	276.90	4,247.80	556.42	-3,256.08	3,302.88	0.46	0.32	-0.32
7,246.00	88.900	276.90	4,248.61	560.27	-3,287.83	3,334.85	2.19	2.19	0.00
7,308.00	90.600	276.60	4,248.88	567.55	-3,349.40	3,396.80	2.78	2.74	-0.48
7,372.00	90.100	276.50	4,248.49	574.85	-3,412.98	3,460.75	0.80	-0.78	-0.16
7,403.00	89.700	275.60	4,248.54	578.12	-3,443.81	3,491.72	3.18	-1.29	-2.90
7,467.00	89.400	274.90	4,249.05	583.98	-3,507.54	3,555.59	1.19	-0.47	-1.09
7,530.00	89.900	275.30	4,249.43	589.58	-3,570.29	3,618.46	1.02	0.79	0.63
7,594.00	89.700	273.50	4,249.65	594.49	-3,634.10	3,682.27	2.83	-0.31	-2.81
7,752.00	90.000	272.80	4,250.07	603.17	-3,791.86	3,839.50	0.48	0.19	-0.44
7,902.00	90.000	272.80	4,250.07	610.50	-3,941.68	3,988.67	0.00	0.00	0.00

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
7,901.00	4,250.07	610.45	-3,940.68	Projection to bit 7902.00 MD, 90.000 INC, 272.80 AZI, 4250.07 TVD

Checked By: _____ Approved By: _____ Date: _____