



Well: Knob Creek S-15HU (slot O)
 Site: Knob Creek
 Project: Marshall County, West Virginia.
 Wellbore: Original Hole
 Design: rev6
 Rig: Nabors X08

Geodetic System: Universal Transverse Mercator (US Survey Feet)
 Datum: NAD83 West Virginia - HARN
 Ellipsoid: GRS 1980
 Zone: Zone 17N (84 W to 78 W)

System Datum: Mean Sea Level
 Depth Reference: RKB=737+33 @ 770.00usft (Nabors X08)
 Surface location

Northing: 14443154.70
 Easting: 1723205.46
 Latitude: 39.77009798
 Longitude: -80.70536548



Azimuths to Grid North
 True North: -0.19°
 Magnetic North: -8.85°

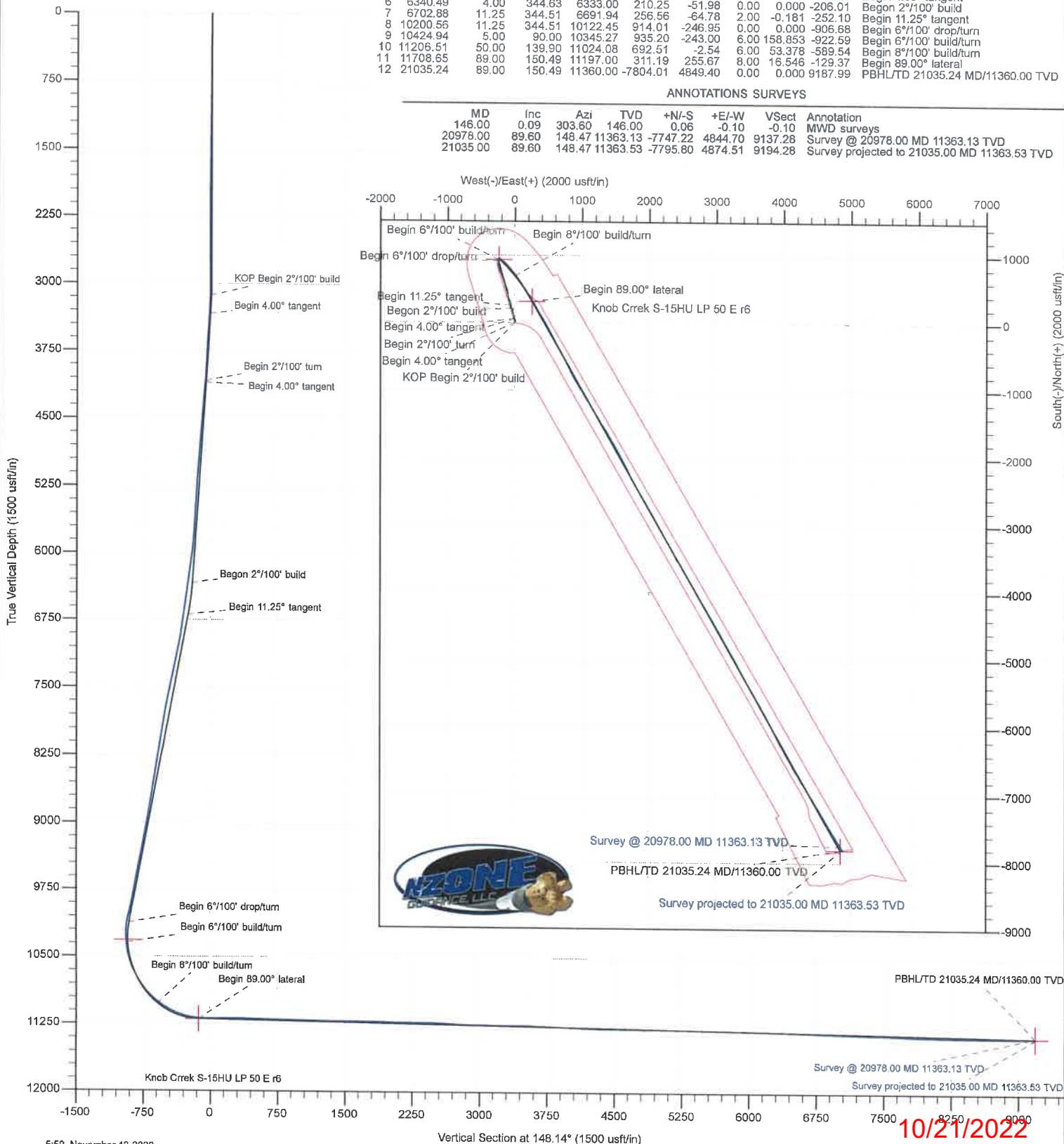
Magnetic Field
 Strength: 51813.2snT
 Dip Angle: 66.59°
 Date: 10/12/2020
 Model: IGRF2020

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.846°
 SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	Vsect	Annotation
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	3133.00	0.00	0.00	3133.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 2°/100' build
3	3333.00	4.00	350.00	3332.84	6.87	-1.21	2.00	350.000	-6.48	Begin 4.00° tangent
4	4083.00	4.00	350.00	4081.01	58.40	-10.30	0.00	0.000	-55.03	Begin 2°/100' turn
5	4101.72	4.00	344.63	4099.69	59.67	-10.58	2.00	-92.678	-56.27	Begin 4.00° tangent
6	6340.49	4.00	344.63	6333.00	210.25	-51.98	0.00	0.000	-206.01	Begin 2°/100' build
7	6702.88	11.25	344.51	6691.94	256.56	-64.78	2.00	-0.181	-252.10	Begin 11.25° tangent
8	10200.56	11.25	344.51	10122.45	914.01	-246.95	0.00	0.000	-905.68	Begin 6°/100' drop/turn
9	10424.94	5.00	90.00	10345.27	935.20	-243.00	6.00	158.853	-922.59	Begin 6°/100' build/turn
10	11206.51	50.00	139.90	11024.08	692.51	-2.54	6.00	53.378	-589.54	Begin 8°/100' build/turn
11	11708.65	89.00	150.49	11197.00	311.19	255.67	8.00	16.546	-129.37	Begin 89.00° lateral
12	21035.24	89.00	150.49	11360.00	-7804.01	4849.40	0.00	0.000	9187.99	PBHL/TD 21035.24 MD/11360.00 TVD

ANNOTATIONS SURVEYS

MD	Inc	Azi	TVD	+N/-S	+E/-W	Vsect	Annotation
146.00	0.09	303.60	146.00	0.06	-0.10	-0.10	MWD surveys
20978.00	89.60	148.47	11363.13	-7747.22	4844.70	9137.28	Survey @ 20978.00 MD 11363.13 TVD
21035.00	89.60	148.47	11363.53	-7795.80	4874.51	9194.28	Survey projected to 21035.00 MD 11363.53 TVD



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Project	Marshall County, West Virginia.		
Map System:	Universal Transverse Mercator (US Survey Feet)	System Datum:	Mean Sea Level
Geo Datum:	NAD83 West Virginia - HARN		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Knob Creek				
Site Position:		Northing:	14,443,053.74 usft	Latitude:	39.76982148
From:	Lat/Long	Easting:	1,723,120.29 usft	Longitude:	-80.70566975
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.188 °

Well	Knob Creek S-15HU (slot O)					
Well Position	+N/-S	0.00 usft	Northing:	14,443,154.70 usft	Latitude:	39.77009798
	+E/-W	0.00 usft	Easting:	1,723,205.46 usft	Longitude:	-80.70536548
Position Uncertainty	0.00 usft		Wellhead Elevation:	usft	Ground Level:	737.00 usft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2020	10/12/2020	-8.658	66.592	51,813.16072191

Design	Surveys Original Hole				
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	148.14	

Survey Program	Date	11/13/2020			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
146.00	2,191.00	MWD surf (Original Hole)	MWD	MWD - Standard	
2,301.00	10,087.00	MWD int (Original Hole)	MWD	MWD - Standard	
10,132.00	20,978.00	MWD lat (Original Hole)	MWD	MWD - Standard	
21,035.00	21,035.00	Projection (Original Hole)	MWD	MWD - Standard	

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)	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
146.00	0.09	303.60	146.00	0.06	-0.10	-0.10	0.06	0.06	0.00	
MWD surveys										
177.00	0.09	236.54	177.00	0.06	-0.14	-0.13	0.32	0.00	-216.32	
208.00	0.04	261.15	208.00	0.05	-0.17	-0.13	0.18	-0.16	79.39	
238.00	0.04	168.86	238.00	0.04	-0.18	-0.12	0.19	0.00	-307.63	
269.00	0.44	287.17	269.00	0.06	-0.29	-0.20	1.48	1.29	381.65	
300.00	0.44	261.15	300.00	0.08	-0.52	-0.34	0.64	0.00	-83.94	

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Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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)
330.00	0.26	261.15	330.00	0.05	-0.70	-0.41	0.60	-0.60	0.00
361.00	0.66	261.15	361.00	0.01	-0.95	-0.51	1.29	1.29	0.00
392.00	0.44	227.58	392.00	-0.10	-1.21	-0.56	1.23	-0.71	-108.29
423.00	0.48	236.45	422.99	-0.25	-1.41	-0.53	0.26	0.13	28.61
453.00	0.48	250.08	452.99	-0.36	-1.63	-0.55	0.38	0.00	45.43
483.00	0.26	244.45	482.99	-0.43	-1.81	-0.59	0.74	-0.73	-18.77
507.00	0.44	206.22	506.99	-0.54	-1.90	-0.54	1.19	0.75	-159.29
545.00	0.26	203.93	544.99	-0.75	-2.00	-0.42	0.48	-0.47	-6.03
606.00	0.31	208.94	605.99	-1.02	-2.13	-0.26	0.09	0.08	8.21
696.00	0.18	334.98	695.99	-1.10	-2.31	-0.28	0.49	-0.14	140.04
790.00	0.70	338.14	789.99	-0.44	-2.59	-0.99	0.55	0.55	3.36
885.00	0.92	324.43	884.98	0.72	-3.25	-2.33	0.31	0.23	-14.43
979.00	0.97	324.52	978.97	1.98	-4.15	-3.87	0.05	0.05	0.10
1,073.00	0.75	328.74	1,072.95	3.16	-4.93	-5.28	0.24	-0.23	4.49
1,166.00	0.66	333.31	1,165.95	4.16	-5.49	-6.42	0.11	-0.10	4.91
1,260.00	0.57	334.45	1,259.94	5.06	-5.93	-7.43	0.10	-0.10	1.21
1,354.00	1.01	0.99	1,353.93	6.31	-6.12	-8.59	0.60	0.47	28.23
1,448.00	1.27	348.95	1,447.91	8.16	-6.30	-10.26	0.37	0.28	-12.81
1,543.00	0.88	357.48	1,542.90	9.92	-6.54	-11.88	0.44	-0.41	8.98
1,637.00	1.05	39.05	1,636.89	11.31	-6.03	-12.79	0.75	0.18	44.22
1,731.00	1.63	54.17	1,730.86	12.77	-4.40	-13.16	0.72	0.62	16.09
1,826.00	1.41	65.68	1,825.83	14.04	-2.24	-13.10	0.40	-0.23	12.12
1,921.00	0.48	7.15	1,920.81	14.91	-1.12	-13.26	1.29	-0.98	-61.61
2,015.00	0.57	13.74	2,014.81	15.76	-0.96	-13.89	0.12	0.10	7.01
2,109.00	0.26	329.97	2,108.81	16.40	-0.96	-14.43	0.45	-0.33	-46.56
2,191.00	0.66	93.19	2,190.81	16.53	-0.58	-14.35	1.01	0.49	150.27
2,301.00	0.18	59.53	2,300.80	16.58	0.20	-13.98	0.47	-0.44	-30.60
2,394.00	0.35	166.84	2,393.80	16.38	0.39	-13.71	0.47	0.18	115.39
2,489.00	0.44	229.42	2,488.80	15.86	0.18	-13.38	0.44	0.09	65.87
2,583.00	0.40	207.10	2,582.80	15.34	-0.24	-13.15	0.18	-0.04	-23.74
2,677.00	0.31	202.35	2,676.80	14.81	-0.49	-12.84	0.10	-0.10	-5.05
2,772.00	0.26	261.15	2,771.80	14.54	-0.80	-12.77	0.30	-0.05	61.89
2,866.00	0.31	70.16	2,865.79	14.59	-0.77	-12.80	0.60	0.05	179.80
2,960.00	0.22	88.97	2,959.79	14.68	-0.35	-12.65	0.13	-0.10	20.01
3,054.00	0.35	74.38	3,053.79	14.76	0.10	-12.48	0.16	0.14	-15.52
3,148.00	1.05	339.37	3,147.79	15.64	0.08	-13.25	1.21	0.74	-101.07
3,241.00	2.29	346.05	3,240.75	18.25	-0.67	-15.85	1.35	1.33	7.18
3,335.00	3.65	340.08	3,334.62	22.88	-2.14	-20.57	1.48	1.45	-6.35
3,430.00	4.31	333.66	3,429.39	28.92	-4.76	-27.08	0.84	0.69	-6.76
3,524.00	3.82	340.78	3,523.15	35.05	-7.36	-33.65	0.75	-0.52	7.57
3,618.00	3.16	349.30	3,616.98	40.55	-8.87	-39.12	0.89	-0.70	9.06
3,712.00	2.90	349.30	3,710.85	45.43	-9.79	-43.75	0.28	-0.28	0.00
3,806.00	2.72	338.58	3,804.73	49.84	-11.05	-48.16	0.59	-0.19	-11.40

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3,899.00	3.25	344.73	3,897.61	54.44	-12.55	-52.86	0.67	0.57	6.61
3,993.00	4.09	350.97	3,991.41	60.32	-13.77	-58.50	0.99	0.89	6.64
4,086.00	5.36	351.06	4,084.10	67.89	-14.97	-65.56	1.37	1.37	0.10
4,180.00	6.37	355.98	4,177.60	77.43	-16.02	-74.22	1.20	1.07	5.23
4,277.00	6.20	355.46	4,274.02	88.02	-16.81	-83.63	0.18	-0.18	-0.54
4,370.00	4.70	355.11	4,366.60	96.82	-17.53	-91.49	1.61	-1.61	-0.38
4,464.00	4.88	348.43	4,460.27	104.57	-18.66	-98.67	0.62	0.19	-7.11
4,559.00	3.69	337.70	4,555.00	111.36	-20.63	-105.47	1.51	-1.25	-11.29
4,653.00	4.09	338.41	4,648.79	117.28	-23.01	-111.76	0.43	0.43	0.76
4,748.00	4.53	338.67	4,743.52	123.92	-25.62	-118.78	0.46	0.46	0.27
4,842.00	5.41	342.89	4,837.16	131.62	-28.28	-126.71	1.01	0.94	4.49
4,937.00	5.36	342.45	4,931.75	140.13	-30.93	-135.34	0.07	-0.05	-0.46
5,031.00	4.39	345.44	5,025.40	147.79	-33.16	-143.03	1.07	-1.03	3.18
5,126.00	4.09	337.88	5,120.15	154.45	-35.35	-149.84	0.67	-0.32	-7.96
5,220.00	4.88	353.70	5,213.86	161.53	-37.05	-156.75	1.55	0.84	16.83
5,315.00	4.31	12.86	5,308.56	169.03	-36.70	-162.94	1.71	-0.60	20.17
5,409.00	4.44	22.26	5,402.29	175.84	-34.54	-167.58	0.77	0.14	10.00
5,503.00	4.44	0.47	5,496.01	182.85	-33.13	-172.79	1.78	0.00	-23.18
5,596.00	3.47	358.44	5,588.79	189.26	-33.18	-178.26	1.05	-1.04	-2.18
5,690.00	3.30	331.81	5,682.63	194.49	-34.53	-183.41	1.67	-0.18	-28.33
5,784.00	4.17	332.69	5,776.43	199.91	-37.38	-189.52	0.93	0.93	0.94
5,878.00	4.75	327.16	5,870.15	206.22	-41.06	-196.82	0.77	0.62	-5.88
5,972.00	6.90	331.37	5,963.66	214.44	-45.87	-206.35	2.33	2.29	4.48
6,066.00	8.09	334.63	6,056.85	225.38	-51.41	-218.56	1.34	1.27	3.47
6,168.00	8.00	336.74	6,157.85	238.38	-57.29	-232.71	0.30	-0.09	2.07
6,263.00	7.29	332.34	6,252.00	249.79	-62.70	-245.26	0.97	-0.75	-4.63
6,356.00	7.43	332.17	6,344.24	260.34	-68.25	-257.14	0.15	0.15	-0.18
6,450.00	8.66	329.00	6,437.31	271.78	-74.73	-270.28	1.39	1.31	-3.37
6,542.00	9.14	328.03	6,528.20	283.92	-82.17	-284.51	0.55	0.52	-1.05
6,636.00	7.95	332.87	6,621.16	296.03	-89.08	-298.46	1.48	-1.27	5.15
6,730.00	7.43	345.61	6,714.32	307.71	-93.56	-310.73	1.89	-0.55	13.55
6,825.00	8.88	353.96	6,808.36	320.95	-95.86	-323.19	1.97	1.53	8.79
6,918.00	11.07	357.57	6,899.95	337.01	-96.99	-337.43	2.45	2.35	3.88
7,012.00	11.69	354.23	6,992.10	355.50	-98.33	-353.85	0.96	0.66	-3.55
7,105.00	11.82	352.73	7,083.15	374.33	-100.48	-370.97	0.36	0.14	-1.61
7,200.00	12.30	352.91	7,176.06	394.02	-102.96	-389.00	0.51	0.51	0.19
7,319.00	13.45	352.47	7,292.06	420.32	-106.34	-413.12	0.97	0.97	-0.37
7,387.00	14.28	352.91	7,358.08	436.48	-108.41	-427.95	1.23	1.22	0.65
7,481.00	12.88	349.22	7,449.45	458.28	-111.80	-448.25	1.75	-1.49	-3.93
7,574.00	12.08	345.79	7,540.25	477.90	-116.13	-467.20	1.17	-0.86	-3.69
7,668.00	11.16	342.54	7,632.33	496.11	-121.28	-485.38	1.20	-0.98	-3.46
7,762.00	9.76	335.77	7,724.77	512.05	-127.28	-502.09	1.98	-1.49	-7.20
7,857.00	10.41	333.57	7,818.30	527.08	-134.40	-518.61	0.80	0.68	-2.32
7,950.00	9.76	333.31	7,909.86	541.65	-141.68	-534.83	0.70	-0.70	-0.28

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8,044.00	9.27	340.78	8,002.57	555.92	-147.75	-550.15	1.41	-0.52	7.95
8,141.00	8.79	342.89	8,098.37	570.38	-152.50	-564.94	0.60	-0.49	2.18
8,235.00	10.06	346.05	8,191.10	585.21	-156.60	-579.70	1.46	1.35	3.36
8,329.00	9.93	343.77	8,283.67	600.96	-160.84	-595.32	0.44	-0.14	-2.43
8,423.00	8.83	340.78	8,376.41	615.56	-165.48	-610.17	1.28	-1.17	-3.18
8,518.00	8.57	343.24	8,470.32	629.22	-169.92	-624.11	0.48	-0.27	2.59
8,612.00	9.93	341.92	8,563.10	643.63	-174.46	-638.75	1.46	1.45	-1.40
8,706.00	9.80	342.98	8,655.71	658.98	-179.32	-654.35	0.24	-0.14	1.13
8,800.00	10.02	339.55	8,748.31	674.30	-184.51	-670.10	0.67	0.23	-3.65
8,894.00	8.79	339.37	8,841.04	688.68	-189.90	-685.16	1.31	-1.31	-0.19
8,988.00	9.58	337.88	8,933.83	702.65	-195.38	-699.92	0.88	0.84	-1.59
9,083.00	11.03	340.25	9,027.30	718.53	-201.43	-716.60	1.59	1.53	2.49
9,177.00	10.41	340.78	9,119.66	735.01	-207.26	-733.67	0.67	-0.66	0.56
9,271.00	10.85	339.37	9,212.05	751.31	-213.17	-750.64	0.54	0.47	-1.50
9,365.00	11.95	336.74	9,304.19	768.53	-220.13	-768.94	1.29	1.17	-2.80
9,459.00	11.78	336.65	9,396.18	786.28	-227.78	-788.05	0.18	-0.18	-0.10
9,551.00	11.51	341.31	9,486.29	803.60	-234.44	-806.28	1.06	-0.29	5.07
9,646.00	10.24	343.33	9,579.58	820.66	-239.90	-823.66	1.40	-1.34	2.13
9,739.00	9.80	347.02	9,671.17	836.30	-244.05	-839.12	0.84	-0.47	3.97
9,832.00	11.12	346.84	9,762.62	852.74	-247.87	-855.11	1.42	1.42	-0.19
9,926.00	11.60	343.68	9,854.78	870.64	-252.59	-872.80	0.84	0.51	-3.36
10,019.00	13.10	343.94	9,945.62	889.74	-258.14	-891.95	1.61	1.61	0.28
10,087.00	14.24	342.80	10,011.70	905.14	-262.74	-907.46	1.72	1.68	-1.68
10,132.00	15.12	343.94	10,055.23	916.06	-266.00	-918.46	2.06	1.96	2.53
10,179.00	12.40	359.76	10,100.89	927.01	-267.72	-928.66	9.83	-5.79	33.66
10,226.00	10.73	19.63	10,146.95	936.18	-266.27	-935.68	9.13	-3.55	42.28
10,273.00	10.64	37.03	10,193.15	943.77	-262.19	-939.97	6.84	-0.19	37.02
10,320.00	10.46	53.90	10,239.37	949.74	-256.12	-941.85	6.56	-0.38	35.89
10,367.00	8.62	71.83	10,285.72	953.36	-249.33	-941.33	7.39	-3.91	38.15
10,413.00	7.74	95.74	10,331.27	954.12	-242.97	-938.62	7.58	-1.91	51.98
10,460.00	10.20	109.28	10,377.69	952.43	-235.89	-933.45	6.86	5.23	28.81
10,508.00	11.26	115.08	10,424.86	949.04	-227.63	-926.21	3.15	2.21	12.08
10,554.00	12.22	120.53	10,469.89	944.67	-219.37	-918.14	3.19	2.09	11.85
10,602.00	14.86	124.39	10,516.56	938.61	-209.91	-908.00	5.81	5.50	8.04
10,649.00	19.17	129.14	10,561.49	930.33	-198.95	-895.18	9.63	9.17	10.11
10,697.00	22.25	131.60	10,606.39	919.32	-186.04	-879.01	6.67	6.42	5.13
10,744.00	24.71	134.06	10,649.49	906.58	-172.32	-860.95	5.63	5.23	5.23
10,791.00	27.08	135.99	10,691.77	892.05	-157.83	-840.96	5.35	5.04	4.11
10,838.00	30.16	135.99	10,733.02	875.86	-142.19	-818.95	6.55	6.55	0.00
10,885.00	33.50	137.22	10,772.95	857.84	-125.17	-794.67	7.24	7.11	2.62
10,932.00	35.44	138.98	10,811.70	838.04	-107.42	-768.48	4.64	4.13	3.74
10,980.00	38.08	139.69	10,850.15	816.25	-88.70	-740.09	5.57	5.50	1.48
11,027.00	40.98	140.56	10,886.40	793.29	-69.53	-710.47	6.28	6.17	1.85

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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)
11,073.00	43.53	142.50	10,920.44	769.07	-50.30	-679.75	6.23	5.54	4.22
11,120.00	46.87	142.50	10,953.55	742.61	-30.00	-646.57	7.11	7.11	0.00
11,167.00	49.86	143.38	10,984.78	714.58	-8.84	-611.59	6.51	6.36	1.87
11,214.00	51.70	143.03	11,014.49	685.42	12.97	-575.31	3.96	3.91	-0.74
11,261.00	54.26	143.90	11,042.79	655.27	35.30	-537.92	5.64	5.45	1.85
11,308.00	59.18	144.61	11,068.57	623.39	58.24	-498.73	10.54	10.47	1.51
11,354.00	62.26	144.26	11,091.07	590.75	81.58	-458.69	6.73	6.70	-0.76
11,401.00	65.69	145.13	11,111.69	556.29	105.98	-416.54	7.48	7.30	1.85
11,448.00	69.20	144.96	11,129.71	520.72	130.84	-373.20	7.48	7.47	-0.36
11,495.00	71.93	145.84	11,145.35	484.24	156.01	-328.94	6.07	5.81	1.87
11,542.00	74.48	146.89	11,158.93	446.78	180.92	-283.97	5.83	5.43	2.23
11,589.00	77.12	147.60	11,170.46	408.46	205.57	-238.41	5.80	5.62	1.51
11,635.00	79.49	148.65	11,179.78	370.21	229.36	-193.37	5.62	5.15	2.28
11,682.00	84.50	148.83	11,186.33	330.44	253.50	-146.85	10.67	10.66	0.38
11,730.00	88.02	149.53	11,189.46	289.31	278.03	-98.97	7.48	7.33	1.46
11,825.00	91.19	149.88	11,190.11	207.30	325.95	-4.02	3.36	3.34	0.37
11,919.00	91.28	149.18	11,188.08	126.30	373.60	89.93	0.75	0.10	-0.74
12,014.00	90.75	148.65	11,186.40	44.96	422.65	184.91	0.79	-0.56	-0.56
12,108.00	90.48	150.94	11,185.39	-36.27	469.93	278.86	2.45	-0.29	2.44
12,202.00	87.85	152.52	11,186.76	-119.04	514.44	372.65	3.26	-2.80	1.68
12,296.00	88.11	152.17	11,190.08	-202.25	558.05	466.34	0.46	0.28	-0.37
12,391.00	87.85	152.52	11,193.42	-286.34	602.11	561.03	0.46	-0.27	0.37
12,485.00	88.90	152.69	11,196.09	-369.77	645.35	654.70	1.13	1.12	0.18
12,580.00	88.72	153.04	11,198.06	-454.29	688.66	749.36	0.41	-0.19	0.37
12,673.00	88.90	151.64	11,199.99	-536.65	731.83	842.09	1.52	0.19	-1.51
12,767.00	88.72	151.81	11,201.95	-619.41	776.35	935.88	0.26	-0.19	0.18
12,861.00	88.99	152.34	11,203.83	-702.45	820.36	1,029.64	0.63	0.29	0.56
12,954.00	88.72	152.87	11,205.68	-785.00	863.14	1,122.34	0.64	-0.29	0.57
13,049.00	88.46	151.11	11,208.02	-868.85	907.74	1,217.09	1.87	-0.27	-1.85
13,142.00	88.46	148.30	11,210.52	-949.11	954.63	1,310.02	3.02	0.00	-3.02
13,237.00	89.43	147.60	11,212.27	-1,029.61	1,005.04	1,405.00	1.26	1.02	-0.74
13,331.00	90.04	149.00	11,212.71	-1,109.59	1,054.43	1,498.99	1.62	0.65	1.49
13,425.00	89.69	148.83	11,212.93	-1,190.09	1,102.96	1,592.98	0.41	-0.37	-0.18
13,519.00	89.60	148.65	11,213.51	-1,270.44	1,151.74	1,686.98	0.21	-0.10	-0.19
13,613.00	89.60	149.00	11,214.17	-1,350.86	1,200.40	1,780.97	0.37	0.00	0.37
13,707.00	89.08	149.18	11,215.25	-1,431.51	1,248.68	1,874.95	0.59	-0.55	0.19
13,801.00	88.29	148.30	11,217.41	-1,511.84	1,297.44	1,968.92	1.26	-0.84	-0.94
13,895.00	88.20	148.30	11,220.28	-1,591.78	1,346.82	2,062.87	0.10	-0.10	0.00
13,989.00	89.34	149.88	11,222.30	-1,672.41	1,395.09	2,156.83	2.07	1.21	1.68
14,083.00	88.64	149.18	11,223.96	-1,753.41	1,442.75	2,250.79	1.05	-0.74	-0.74
14,177.00	89.96	149.35	11,225.11	-1,834.20	1,490.78	2,344.76	1.42	1.40	0.18
14,271.00	89.69	151.99	11,225.39	-1,916.14	1,536.82	2,438.66	2.82	-0.29	2.81
14,364.00	86.88	153.04	11,228.18	-1,998.60	1,579.72	2,531.34	3.23	-3.02	1.13

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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)
14,459.00	86.70	153.22	11,233.50	-2,083.21	1,622.59	2,625.83	0.27	-0.19	0.19
14,554.00	87.41	152.17	11,238.38	-2,167.51	1,666.11	2,720.40	1.33	0.75	-1.11
14,648.00	87.93	151.29	11,242.20	-2,250.23	1,710.60	2,814.14	1.09	0.55	-0.94
14,742.00	89.08	150.76	11,244.65	-2,332.43	1,756.11	2,907.99	1.35	1.22	-0.56
14,835.00	88.81	150.23	11,246.36	-2,413.36	1,801.91	3,000.89	0.64	-0.29	-0.57
14,930.00	89.52	150.58	11,247.75	-2,495.95	1,848.82	3,095.81	0.83	0.75	0.37
15,023.00	88.90	150.58	11,249.03	-2,576.95	1,894.50	3,188.71	0.67	-0.67	0.00
15,117.00	89.78	150.41	11,250.11	-2,658.76	1,940.79	3,282.63	0.95	0.94	-0.18
15,211.00	89.52	150.58	11,250.69	-2,740.56	1,987.08	3,376.55	0.33	-0.28	0.18
15,305.00	89.52	150.41	11,251.48	-2,822.37	2,033.38	3,470.46	0.18	0.00	-0.18
15,400.00	87.58	151.11	11,253.88	-2,905.23	2,079.77	3,565.33	2.17	-2.04	0.74
15,494.00	87.93	150.94	11,257.56	-2,987.41	2,125.27	3,659.14	0.41	0.37	-0.18
15,589.00	87.93	150.58	11,260.99	-3,070.25	2,171.64	3,753.98	0.38	0.00	-0.38
15,683.00	87.58	151.11	11,264.68	-3,152.27	2,217.40	3,847.80	0.68	-0.37	0.56
15,778.00	87.05	151.11	11,269.13	-3,235.36	2,263.25	3,942.57	0.56	-0.56	0.00
15,872.00	87.67	150.94	11,273.46	-3,317.51	2,308.73	4,036.35	0.68	0.66	-0.18
15,966.00	89.08	150.41	11,276.12	-3,399.42	2,354.75	4,130.21	1.60	1.50	-0.56
16,061.00	88.81	150.41	11,277.87	-3,482.02	2,401.65	4,225.12	0.28	-0.28	0.00
16,155.00	89.96	150.06	11,278.88	-3,563.61	2,448.32	4,319.05	1.28	1.22	-0.37
16,249.00	89.52	150.06	11,279.31	-3,645.07	2,495.23	4,413.00	0.47	-0.47	0.00
16,343.00	89.08	149.70	11,280.45	-3,726.37	2,542.40	4,506.95	0.60	-0.47	-0.38
16,438.00	89.87	149.70	11,281.32	-3,808.39	2,590.32	4,601.91	0.83	0.83	0.00
16,532.00	89.78	149.35	11,281.61	-3,889.40	2,638.00	4,695.88	0.38	-0.10	-0.37
16,626.00	89.16	150.58	11,282.48	-3,970.77	2,685.04	4,789.83	1.47	-0.66	1.31
16,720.00	88.99	150.94	11,284.00	-4,052.78	2,730.95	4,883.72	0.42	-0.18	0.38
16,814.00	88.11	150.23	11,286.38	-4,134.64	2,777.11	4,977.60	1.20	-0.94	-0.76
16,908.00	89.16	150.23	11,288.62	-4,216.21	2,823.76	5,071.51	1.12	1.12	0.00
17,002.00	88.81	150.41	11,290.28	-4,297.86	2,870.30	5,165.43	0.42	-0.37	0.19
17,095.00	89.43	150.23	11,291.71	-4,378.65	2,916.35	5,258.35	0.69	0.67	-0.19
17,190.00	89.08	150.23	11,292.95	-4,461.11	2,963.51	5,353.28	0.37	-0.37	0.00
17,284.00	88.99	150.76	11,294.53	-4,542.91	3,009.80	5,447.18	0.57	-0.10	0.56
17,378.00	89.16	150.23	11,296.05	-4,624.70	3,056.09	5,541.09	0.59	0.18	-0.56
17,471.00	88.99	150.41	11,297.55	-4,705.49	3,102.13	5,634.01	0.27	-0.18	0.19
17,566.00	89.34	150.76	11,298.93	-4,788.24	3,148.78	5,728.91	0.52	0.37	0.37
17,660.00	89.16	150.58	11,300.16	-4,870.18	3,194.82	5,822.81	0.27	-0.19	-0.19
17,754.00	88.72	150.23	11,301.90	-4,951.90	3,241.24	5,916.72	0.60	-0.47	-0.37
17,847.00	88.72	150.41	11,303.98	-5,032.68	3,287.28	6,009.63	0.19	0.00	0.19
17,940.00	88.55	151.11	11,306.19	-5,113.81	3,332.69	6,102.51	0.77	-0.18	0.75
18,033.00	88.81	151.29	11,308.34	-5,195.28	3,377.48	6,195.35	0.34	0.28	0.19
18,126.00	89.08	151.99	11,310.05	-5,277.11	3,421.65	6,288.16	0.81	0.29	0.75
18,220.00	88.64	150.94	11,311.92	-5,359.67	3,466.54	6,381.98	1.21	-0.47	-1.12
18,314.00	89.43	149.88	11,313.50	-5,441.40	3,512.95	6,475.89	1.41	0.84	-1.13
18,407.00	88.81	149.88	11,314.93	-5,521.83	3,559.62	6,568.84	0.67	-0.67	0.00
18,501.00	88.81	149.70	11,316.88	-5,603.05	3,606.90	6,662.78	0.19	0.00	-0.19

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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)
18,596.00	89.08	150.23	11,318.63	-5,685.27	3,654.45	6,757.72	0.63	0.28	0.56
18,690.00	88.02	151.64	11,321.01	-5,767.41	3,700.10	6,851.57	1.88	-1.13	1.50
18,784.00	88.37	152.34	11,323.97	-5,850.36	3,744.22	6,945.31	0.83	0.37	0.74
18,878.00	88.55	151.99	11,326.50	-5,933.45	3,788.09	7,039.05	0.42	0.19	-0.37
18,972.00	88.81	152.17	11,328.66	-6,016.49	3,832.10	7,132.80	0.34	0.28	0.19
19,066.00	88.11	151.29	11,331.19	-6,099.24	3,876.60	7,226.58	1.20	-0.74	-0.94
19,160.00	88.37	151.11	11,334.08	-6,181.58	3,921.86	7,320.40	0.34	0.28	-0.19
19,254.00	88.81	151.29	11,336.39	-6,263.92	3,967.13	7,414.24	0.51	0.47	0.19
19,348.00	89.25	151.81	11,337.98	-6,346.56	4,011.91	7,508.06	0.72	0.47	0.55
19,442.00	87.76	150.23	11,340.43	-6,428.76	4,057.43	7,601.90	2.31	-1.59	-1.68
19,536.00	87.93	149.88	11,343.97	-6,510.15	4,104.32	7,695.78	0.41	0.18	-0.37
19,630.00	88.11	150.06	11,347.22	-6,591.48	4,151.34	7,789.68	0.27	0.19	0.19
19,724.00	88.02	150.06	11,350.39	-6,672.89	4,198.22	7,883.57	0.10	-0.10	0.00
19,818.00	88.64	149.18	11,353.13	-6,753.95	4,245.74	7,977.50	1.14	0.66	-0.94
19,912.00	89.08	149.00	11,355.00	-6,834.58	4,294.02	8,071.47	0.51	0.47	-0.19
20,005.00	88.99	148.65	11,356.57	-6,914.14	4,342.15	8,164.45	0.39	-0.10	-0.38
20,100.00	89.16	148.47	11,358.10	-6,995.18	4,391.70	8,259.43	0.26	0.18	-0.19
20,193.00	89.34	148.47	11,359.32	-7,074.45	4,440.33	8,352.42	0.19	0.19	0.00
20,286.00	89.60	148.12	11,360.18	-7,153.56	4,489.20	8,445.42	0.47	0.28	-0.38
20,380.00	89.60	148.30	11,360.83	-7,233.46	4,538.72	8,539.42	0.19	0.00	0.19
20,474.00	89.43	149.88	11,361.63	-7,314.11	4,587.01	8,633.40	1.69	-0.18	1.68
20,567.00	89.43	149.35	11,362.55	-7,394.33	4,634.04	8,726.36	0.57	0.00	-0.57
20,661.00	89.96	149.70	11,363.05	-7,475.34	4,681.72	8,820.33	0.68	0.56	0.37
20,756.00	90.13	149.35	11,362.98	-7,557.22	4,729.90	8,915.30	0.41	0.18	-0.37
20,849.00	90.13	148.83	11,362.77	-7,637.01	4,777.67	9,008.29	0.56	0.00	-0.56
20,943.00	89.69	148.65	11,362.92	-7,717.36	4,826.45	9,102.28	0.51	-0.47	-0.19
20,978.00	89.60	148.47	11,363.13	-7,747.22	4,844.70	9,137.28	0.57	-0.26	-0.51
Survey @ 20978.00 MD 11363.13 TVD									
21,035.00	89.60	148.47	11,363.53	-7,795.80	4,874.51	9,194.28	0.00	0.00	0.00
Survey projected to 21035.00 MD 11363.53 TVD									

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
146.00	146.00	0.06	-0.10	MWD surveys
20,978.00	11,363.13	-7,747.22	4,844.70	Survey @ 20978.00 MD 11363.13 TVD

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Project	Marshall County, West Virginia.		
Map System:	Universal Transverse Mercator (US Survey Feet)	System Datum:	Mean Sea Level
Geo Datum:	NAD83 West Virginia - HARN		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Knob Creek				
Site Position:		Northing:	14,443,053.74 usft	Latitude:	39.76982148
From:	Lat/Long	Easting:	1,723,120.29 usft	Longitude:	-80.70566975
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.188 °

Well	Knob Creek S-15HU (slot O)					
Well Position	+N/-S	0.00 usft	Northing:	14,443,154.70 usft	Latitude:	39.77009798
	+E/-W	0.00 usft	Easting:	1,723,205.46 usft	Longitude:	-80.70536548
Position Uncertainty	0.00 usft		Wellhead Elevation:	usft	Ground Level:	737.00 usft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2020	10/12/2020	-8.658	66.592	51,813.16072191

Design	Surveys Original Hole				
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	148.14	

Survey Program	Date 11/13/2020				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
146.00	2,191.00	MWD surf (Original Hole)	MWD	MWD - Standard	
2,301.00	10,087.00	MWD int (Original Hole)	MWD	MWD - Standard	
10,132.00	20,978.00	MWD lat (Original Hole)	MWD	MWD - Standard	
21,035.00	21,035.00	Projection (Original Hole)	MWD	MWD - Standard	

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
0.00	0.00	0.00	0.00	0.00	0.00	14,443,154.70	1,723,205.46	39.77009798	-80.70536548	
146.00	0.09	303.60	146.00	0.06	-0.10	14,443,154.76	1,723,205.36	39.77009816	-80.70536582	
MWD surveys										
177.00	0.09	236.54	177.00	0.06	-0.14	14,443,154.76	1,723,205.32	39.77009816	-80.70536596	
208.00	0.04	261.15	208.00	0.05	-0.17	14,443,154.75	1,723,205.29	39.77009812	-80.70536607	
238.00	0.04	168.86	238.00	0.04	-0.18	14,443,154.73	1,723,205.29	39.77009808	-80.70536610	
269.00	0.44	287.17	269.00	0.06	-0.29	14,443,154.76	1,723,205.17	39.77009815	-80.70536650	
300.00	0.44	261.15	300.00	0.08	-0.52	14,443,154.78	1,723,204.94	39.77009820	-80.70536732	
330.00	0.26	261.15	330.00	0.05	-0.70	14,443,154.75	1,723,204.76	39.77009812	-80.70536797	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
361.00	0.66	261.15	361.00	0.01	-0.95	14,443,154.71	1,723,204.52	39.77009802	-80.70536884	
392.00	0.44	227.58	392.00	-0.10	-1.21	14,443,154.60	1,723,204.25	39.77009773	-80.70536979	
423.00	0.48	236.45	422.99	-0.25	-1.41	14,443,154.45	1,723,204.05	39.77009731	-80.70537049	
453.00	0.48	250.08	452.99	-0.36	-1.63	14,443,154.34	1,723,203.83	39.77009701	-80.70537128	
483.00	0.26	244.45	482.99	-0.43	-1.81	14,443,154.27	1,723,203.65	39.77009681	-80.70537192	
507.00	0.44	206.22	506.99	-0.54	-1.90	14,443,154.16	1,723,203.56	39.77009652	-80.70537224	
545.00	0.26	203.93	544.99	-0.75	-2.00	14,443,153.95	1,723,203.46	39.77009594	-80.70537260	
606.00	0.31	208.94	605.99	-1.02	-2.13	14,443,153.68	1,723,203.33	39.77009520	-80.70537309	
696.00	0.18	334.98	695.99	-1.10	-2.31	14,443,153.59	1,723,203.15	39.77009497	-80.70537372	
790.00	0.70	338.14	789.99	-0.44	-2.59	14,443,154.26	1,723,202.87	39.77009680	-80.70537469	
885.00	0.92	324.43	884.98	0.72	-3.25	14,443,155.42	1,723,202.21	39.77009999	-80.70537703	
979.00	0.97	324.52	978.97	1.98	-4.15	14,443,156.68	1,723,201.31	39.77010346	-80.70538022	
1,073.00	0.75	328.74	1,072.95	3.16	-4.93	14,443,157.86	1,723,200.53	39.77010670	-80.70538298	
1,166.00	0.66	333.31	1,165.95	4.16	-5.49	14,443,158.85	1,723,199.98	39.77010944	-80.70538495	
1,260.00	0.57	334.45	1,259.94	5.06	-5.93	14,443,159.76	1,723,199.53	39.77011193	-80.70538653	
1,354.00	1.01	0.99	1,353.93	6.31	-6.12	14,443,161.01	1,723,199.34	39.77011537	-80.70538718	
1,448.00	1.27	348.95	1,447.91	8.16	-6.30	14,443,162.86	1,723,199.16	39.77012045	-80.70538782	
1,543.00	0.88	357.48	1,542.90	9.92	-6.54	14,443,164.62	1,723,198.92	39.77012529	-80.70538863	
1,637.00	1.05	39.05	1,636.89	11.31	-6.03	14,443,166.01	1,723,199.43	39.77012911	-80.70538679	
1,731.00	1.63	54.17	1,730.86	12.77	-4.40	14,443,167.46	1,723,201.06	39.77013308	-80.70538099	
1,826.00	1.41	65.68	1,825.83	14.04	-2.24	14,443,168.74	1,723,203.22	39.77013655	-80.70537328	
1,921.00	0.48	7.15	1,920.81	14.91	-1.12	14,443,169.61	1,723,204.34	39.77013895	-80.70536931	
2,015.00	0.57	13.74	2,014.81	15.76	-0.96	14,443,170.46	1,723,204.50	39.77014127	-80.70536873	
2,109.00	0.26	329.97	2,108.81	16.40	-0.96	14,443,171.10	1,723,204.50	39.77014302	-80.70536870	
2,191.00	0.66	93.19	2,190.81	16.53	-0.58	14,443,171.23	1,723,204.88	39.77014339	-80.70536736	
2,301.00	0.18	59.53	2,300.80	16.58	0.20	14,443,171.28	1,723,205.66	39.77014353	-80.70536457	
2,394.00	0.35	166.84	2,393.80	16.38	0.39	14,443,171.08	1,723,205.85	39.77014297	-80.70536390	
2,489.00	0.44	229.42	2,488.80	15.86	0.18	14,443,170.56	1,723,205.64	39.77014154	-80.70536465	
2,583.00	0.40	207.10	2,582.80	15.34	-0.24	14,443,170.03	1,723,205.22	39.77014010	-80.70536617	
2,677.00	0.31	202.35	2,676.80	14.81	-0.49	14,443,169.51	1,723,204.97	39.77013865	-80.70536705	
2,772.00	0.26	261.15	2,771.80	14.54	-0.80	14,443,169.24	1,723,204.66	39.77013791	-80.70536816	
2,866.00	0.31	70.16	2,865.79	14.59	-0.77	14,443,169.29	1,723,204.69	39.77013806	-80.70536806	
2,960.00	0.22	88.97	2,959.79	14.68	-0.35	14,443,169.38	1,723,205.11	39.77013830	-80.70536656	
3,054.00	0.35	74.38	3,053.79	14.76	0.10	14,443,169.46	1,723,205.56	39.77013852	-80.70536494	
3,148.00	1.05	339.37	3,147.79	15.64	0.08	14,443,170.34	1,723,205.54	39.77014095	-80.70536502	
3,241.00	2.29	346.05	3,240.75	18.25	-0.67	14,443,172.94	1,723,204.79	39.77014809	-80.70536765	
3,335.00	3.65	340.08	3,334.62	22.88	-2.14	14,443,177.58	1,723,203.32	39.77016084	-80.70537284	
3,430.00	4.31	333.66	3,429.39	28.92	-4.76	14,443,183.62	1,723,200.70	39.77017746	-80.70538207	
3,524.00	3.82	340.78	3,523.15	35.05	-7.36	14,443,189.74	1,723,198.11	39.77019429	-80.70539125	
3,618.00	3.16	349.30	3,616.98	40.55	-8.87	14,443,195.25	1,723,196.59	39.77020942	-80.70539656	
3,712.00	2.90	349.30	3,710.85	45.43	-9.79	14,443,200.13	1,723,195.67	39.77022283	-80.70539979	
3,806.00	2.72	338.58	3,804.73	49.84	-11.05	14,443,204.54	1,723,194.41	39.77023497	-80.70540421	
3,899.00	3.25	344.73	3,897.61	54.44	-12.55	14,443,209.14	1,723,192.91	39.77024760	-80.70540949	
3,993.00	4.09	350.97	3,991.41	60.32	-13.77	14,443,215.02	1,723,191.69	39.77026377	-80.70541379	
4,086.00	5.36	351.06	4,084.10	67.89	-14.97	14,443,222.59	1,723,190.49	39.77028456	-80.70541796	
4,180.00	6.37	355.98	4,177.60	77.43	-16.02	14,443,232.13	1,723,189.44	39.77031076	-80.70542158	
4,277.00	6.20	355.46	4,274.02	88.02	-16.81	14,443,242.72	1,723,188.65	39.77033985	-80.70542427	
4,370.00	4.70	355.11	4,366.60	96.82	-17.53	14,443,251.52	1,723,187.93	39.77036403	-80.70542674	
4,464.00	4.88	348.43	4,460.27	104.57	-18.66	14,443,259.27	1,723,186.80	39.77038534	-80.70543067	
4,559.00	3.69	337.70	4,555.00	111.36	-20.63	14,443,266.06	1,723,184.83	39.77040400	-80.70543760	
4,653.00	4.09	338.41	4,648.79	117.28	-23.01	14,443,271.98	1,723,182.45	39.77042027	-80.70544601	
4,748.00	4.53	338.67	4,743.52	123.92	-25.62	14,443,278.62	1,723,179.84	39.77043854	-80.70545522	
4,842.00	5.41	342.89	4,837.16	131.62	-28.28	14,443,286.31	1,723,177.18	39.77045969	-80.70546458	
4,937.00	5.36	342.45	4,931.75	140.13	-30.93	14,443,294.82	1,723,174.53	39.77048309	-80.70547393	
5,031.00	4.39	345.44	5,025.40	147.79	-33.16	14,443,302.49	1,723,172.30	39.77050416	-80.70548177	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Survey									
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
5,126.00	4.09	337.88	5,120.15	154.45	-35.35	14,443,309.15	1,723,170.11	39.77052247	-80.70548949
5,220.00	4.88	353.70	5,213.86	161.53	-37.05	14,443,316.23	1,723,168.41	39.77054193	-80.70549546
5,315.00	4.31	12.86	5,308.56	169.03	-36.70	14,443,323.73	1,723,168.76	39.77056251	-80.70549412
5,409.00	4.44	22.26	5,402.29	175.84	-34.54	14,443,330.54	1,723,170.92	39.77058120	-80.70548634
5,503.00	4.44	0.47	5,496.01	182.85	-33.13	14,443,337.55	1,723,172.33	39.77060043	-80.70548124
5,596.00	3.47	358.44	5,588.79	189.26	-33.18	14,443,343.96	1,723,172.28	39.77061804	-80.70548134
5,690.00	3.30	331.81	5,682.63	194.49	-34.53	14,443,349.19	1,723,170.93	39.77063241	-80.70548610
5,784.00	4.17	332.69	5,776.43	199.91	-37.38	14,443,354.61	1,723,168.08	39.77064733	-80.70549616
5,878.00	4.75	327.16	5,870.15	206.22	-41.06	14,443,360.92	1,723,164.40	39.77066468	-80.70550918
5,972.00	6.90	331.37	5,963.66	214.44	-45.87	14,443,369.14	1,723,159.59	39.77068732	-80.70552623
6,066.00	8.09	334.63	6,056.85	225.38	-51.41	14,443,380.08	1,723,154.05	39.77071739	-80.70554582
6,168.00	8.00	336.74	6,157.85	238.38	-57.29	14,443,393.08	1,723,148.17	39.77075316	-80.70556658
6,263.00	7.29	332.34	6,252.00	249.79	-62.70	14,443,404.49	1,723,142.76	39.77078455	-80.70558570
6,356.00	7.43	332.17	6,344.24	260.34	-68.25	14,443,415.04	1,723,137.21	39.77081356	-80.70560531
6,450.00	8.66	329.00	6,437.31	271.78	-74.73	14,443,426.48	1,723,130.73	39.77084504	-80.70562925
6,542.00	9.14	328.03	6,528.20	283.92	-82.17	14,443,438.61	1,723,123.30	39.77087843	-80.70565457
6,636.00	7.95	332.87	6,621.16	296.03	-89.08	14,443,450.73	1,723,116.38	39.77091178	-80.70567905
6,730.00	7.43	345.61	6,714.32	307.71	-93.56	14,443,462.41	1,723,111.90	39.77094388	-80.70569484
6,825.00	8.88	353.96	6,808.36	320.95	-95.86	14,443,475.65	1,723,109.60	39.77098026	-80.70570286
6,918.00	11.07	357.57	6,899.95	337.01	-96.99	14,443,491.71	1,723,108.47	39.77102438	-80.70570671
7,012.00	11.69	354.23	6,992.10	355.50	-98.33	14,443,510.20	1,723,107.13	39.77107518	-80.70571126
7,105.00	11.82	352.73	7,083.15	374.33	-100.48	14,443,529.02	1,723,104.98	39.77112689	-80.70571870
7,200.00	12.30	352.91	7,176.06	394.02	-102.96	14,443,548.72	1,723,102.50	39.77118099	-80.70572730
7,319.00	13.45	352.47	7,292.06	420.32	-106.34	14,443,575.02	1,723,099.12	39.77125325	-80.70573902
7,387.00	14.28	352.91	7,358.08	436.48	-108.41	14,443,591.18	1,723,097.05	39.77129765	-80.70574620
7,481.00	12.88	349.22	7,449.45	458.28	-111.80	14,443,612.98	1,723,093.66	39.77135755	-80.70575801
7,574.00	12.08	345.79	7,540.25	477.90	-116.13	14,443,632.59	1,723,089.33	39.77141146	-80.70577318
7,668.00	11.16	342.54	7,632.33	496.11	-121.28	14,443,650.81	1,723,084.19	39.77146152	-80.70579128
7,762.00	9.76	335.77	7,724.77	512.05	-127.28	14,443,666.75	1,723,078.19	39.77150536	-80.70581245
7,857.00	10.41	333.57	7,818.30	527.08	-134.40	14,443,681.78	1,723,071.06	39.77154670	-80.70583763
7,950.00	9.76	333.31	7,909.86	541.65	-141.68	14,443,696.35	1,723,063.78	39.77158677	-80.70586337
8,044.00	9.27	340.78	8,002.57	555.92	-147.75	14,443,710.62	1,723,057.71	39.77162601	-80.70588481
8,141.00	8.79	342.89	8,098.37	570.38	-152.50	14,443,725.08	1,723,052.96	39.77166577	-80.70590155
8,235.00	10.06	346.05	8,191.10	585.21	-156.60	14,443,739.91	1,723,048.86	39.77170654	-80.70591594
8,329.00	9.93	343.77	8,283.67	600.96	-160.84	14,443,755.66	1,723,044.62	39.77174983	-80.70593087
8,423.00	8.83	340.78	8,376.41	615.56	-165.48	14,443,770.25	1,723,039.98	39.77178995	-80.70594721
8,518.00	8.57	343.24	8,470.32	629.22	-169.92	14,443,783.92	1,723,035.54	39.77182752	-80.70596286
8,612.00	9.93	341.92	8,563.10	643.63	-174.46	14,443,798.33	1,723,031.00	39.77186714	-80.70597883
8,706.00	9.80	342.98	8,655.71	658.98	-179.32	14,443,813.68	1,723,026.14	39.77190935	-80.70599594
8,800.00	10.02	339.55	8,748.31	674.30	-184.51	14,443,828.99	1,723,020.95	39.77195144	-80.70601426
8,894.00	8.79	339.37	8,841.04	688.68	-189.90	14,443,843.38	1,723,015.56	39.77199100	-80.70603327
8,988.00	9.58	337.88	8,933.83	702.65	-195.38	14,443,857.35	1,723,010.08	39.77202941	-80.70605259
9,083.00	11.03	340.25	9,027.30	718.53	-201.43	14,443,873.22	1,723,004.03	39.77207306	-80.70607393
9,177.00	10.41	340.78	9,119.66	735.01	-207.26	14,443,889.71	1,722,998.20	39.77211838	-80.70609450
9,271.00	10.85	339.37	9,212.05	751.31	-213.17	14,443,906.01	1,722,992.29	39.77216320	-80.70611535
9,365.00	11.95	336.74	9,304.19	768.53	-220.13	14,443,923.23	1,722,985.33	39.77221055	-80.70613993
9,459.00	11.78	336.65	9,396.18	786.28	-227.78	14,443,940.98	1,722,977.68	39.77225937	-80.70616693
9,551.00	11.51	341.31	9,486.29	803.60	-234.44	14,443,958.29	1,722,971.02	39.77230699	-80.70619044
9,646.00	10.24	343.33	9,579.58	820.66	-239.90	14,443,975.36	1,722,965.56	39.77235391	-80.70620968
9,739.00	9.80	347.02	9,671.17	836.30	-244.05	14,443,990.99	1,722,961.41	39.77239688	-80.70622426
9,832.00	11.12	346.84	9,762.62	852.74	-247.87	14,444,007.44	1,722,957.59	39.77244208	-80.70623766
9,926.00	11.60	343.68	9,854.78	870.64	-252.59	14,444,025.34	1,722,952.87	39.77249127	-80.70625425
10,019.00	13.10	343.94	9,945.62	889.74	-258.14	14,444,044.44	1,722,947.33	39.77254378	-80.70627375
10,087.00	14.24	342.80	10,011.70	905.14	-262.74	14,444,059.84	1,722,942.72	39.77258610	-80.70628996
10,132.00	15.12	343.94	10,055.23	916.06	-266.00	14,444,070.76	1,722,939.46	39.77261614	-80.70630144

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
13,801.00	88.29	148.30	11,217.41	-1,511.84	1,297.44	14,441,642.86	1,724,502.91	39.76593426	-80.70076608	
13,895.00	88.20	148.30	11,220.28	-1,591.78	1,346.82	14,441,562.92	1,724,552.28	39.76571427	-80.70059134	
13,989.00	89.34	149.88	11,222.30	-1,672.41	1,395.09	14,441,482.29	1,724,600.55	39.76549240	-80.70042051	
14,083.00	88.64	149.18	11,223.96	-1,753.41	1,442.75	14,441,401.29	1,724,648.21	39.76526950	-80.70025188	
14,177.00	89.96	149.35	11,225.11	-1,834.20	1,490.78	14,441,320.50	1,724,696.24	39.76504719	-80.70008190	
14,271.00	89.69	151.99	11,225.39	-1,916.14	1,536.82	14,441,238.56	1,724,742.28	39.76482173	-80.69991904	
14,364.00	86.88	153.04	11,228.18	-1,998.60	1,579.72	14,441,156.10	1,724,785.18	39.76459489	-80.69976737	
14,459.00	86.70	153.22	11,233.50	-2,083.21	1,622.59	14,441,071.49	1,724,828.05	39.76436214	-80.69961583	
14,554.00	87.41	152.17	11,238.38	-2,167.51	1,666.11	14,440,987.19	1,724,871.57	39.76413022	-80.69946197	
14,648.00	87.93	151.29	11,242.20	-2,250.23	1,710.60	14,440,904.47	1,724,916.06	39.76390264	-80.69930466	
14,742.00	89.08	150.76	11,244.65	-2,332.43	1,756.11	14,440,822.27	1,724,961.58	39.76367647	-80.69914366	
14,835.00	88.81	150.23	11,246.36	-2,413.36	1,801.91	14,440,741.34	1,725,007.37	39.76345380	-80.69898167	
14,930.00	89.52	150.58	11,247.75	-2,495.95	1,848.82	14,440,658.74	1,725,054.28	39.76322654	-80.69881572	
15,023.00	88.90	150.58	11,249.03	-2,576.95	1,894.50	14,440,577.75	1,725,099.96	39.76300367	-80.69865415	
15,117.00	89.78	150.41	11,250.11	-2,658.76	1,940.79	14,440,495.94	1,725,146.25	39.76277859	-80.69849040	
15,211.00	89.52	150.58	11,250.69	-2,740.56	1,987.08	14,440,414.13	1,725,192.55	39.76255350	-80.69832665	
15,305.00	89.52	150.41	11,251.48	-2,822.37	2,033.38	14,440,332.33	1,725,238.84	39.76232840	-80.69816289	
15,400.00	87.58	151.11	11,253.88	-2,905.23	2,079.77	14,440,249.46	1,725,285.23	39.76210041	-80.69799882	
15,494.00	87.93	150.94	11,257.56	-2,987.41	2,125.27	14,440,167.29	1,725,330.73	39.76187432	-80.69783790	
15,589.00	87.93	150.58	11,260.99	-3,070.25	2,171.64	14,440,084.45	1,725,377.10	39.76164639	-80.69767387	
15,683.00	87.58	151.11	11,264.68	-3,152.27	2,217.40	14,440,002.42	1,725,422.86	39.76142070	-80.69751203	
15,778.00	87.05	151.11	11,269.13	-3,235.36	2,263.25	14,439,919.34	1,725,468.71	39.76119210	-80.69734989	
15,872.00	87.87	150.94	11,273.46	-3,317.51	2,308.73	14,439,837.19	1,725,514.19	39.76096608	-80.69718902	
15,966.00	89.08	150.41	11,276.12	-3,399.42	2,354.75	14,439,755.27	1,725,560.21	39.76074068	-80.69702625	
16,061.00	88.81	150.41	11,277.87	-3,482.02	2,401.65	14,439,672.68	1,725,607.11	39.76051341	-80.69686036	
16,155.00	89.96	150.06	11,278.88	-3,563.61	2,448.32	14,439,591.09	1,725,653.78	39.76028891	-80.69669530	
16,249.00	89.52	150.06	11,279.31	-3,645.07	2,495.23	14,439,509.63	1,725,700.69	39.76006477	-80.69652935	
16,343.00	89.08	149.70	11,280.45	-3,726.37	2,542.40	14,439,428.33	1,725,747.86	39.75984106	-80.69636249	
16,438.00	89.87	149.70	11,281.32	-3,808.39	2,590.32	14,439,346.31	1,725,795.79	39.75961537	-80.69619294	
16,532.00	89.78	149.35	11,281.61	-3,889.40	2,638.00	14,439,265.30	1,725,843.46	39.75939244	-80.69602429	
16,626.00	89.16	150.58	11,282.48	-3,970.77	2,685.04	14,439,183.93	1,725,890.50	39.75916853	-80.69585786	
16,720.00	88.99	150.94	11,284.00	-4,052.78	2,730.95	14,439,101.91	1,725,936.41	39.75894288	-80.69569550	
16,814.00	88.11	150.23	11,286.38	-4,134.64	2,777.11	14,439,020.06	1,725,982.57	39.75871765	-80.69553227	
16,908.00	89.16	150.23	11,288.62	-4,216.21	2,823.76	14,438,938.49	1,726,029.22	39.75849320	-80.69536723	
17,002.00	88.81	150.41	11,290.28	-4,297.86	2,870.30	14,438,856.83	1,726,075.76	39.75826852	-80.69520263	
17,095.00	89.43	150.23	11,291.71	-4,378.65	2,916.35	14,438,776.05	1,726,121.81	39.75804622	-80.69503978	
17,190.00	89.08	150.23	11,292.95	-4,461.11	2,963.51	14,438,693.59	1,726,168.97	39.75781934	-80.69487295	
17,284.00	88.99	150.76	11,294.53	-4,542.91	3,009.80	14,438,611.79	1,726,215.26	39.75759427	-80.69470924	
17,378.00	89.16	150.23	11,296.05	-4,624.70	3,056.09	14,438,529.99	1,726,261.55	39.75736919	-80.69454553	
17,471.00	88.99	150.41	11,297.55	-4,705.49	3,102.13	14,438,449.21	1,726,307.59	39.75714689	-80.69438268	
17,566.00	89.34	150.76	11,298.93	-4,788.24	3,148.78	14,438,366.46	1,726,354.24	39.75691922	-80.69421769	
17,660.00	89.16	150.58	11,300.16	-4,870.18	3,194.82	14,438,284.52	1,726,400.28	39.75669375	-80.69405486	
17,754.00	88.72	150.23	11,301.90	-4,951.90	3,241.24	14,438,202.80	1,726,446.70	39.75646888	-80.69389071	
17,847.00	88.72	150.41	11,303.98	-5,032.68	3,287.28	14,438,122.02	1,726,492.74	39.75624611	-80.69372788	
17,940.00	88.55	151.11	11,306.19	-5,113.81	3,332.69	14,438,040.89	1,726,538.15	39.75602339	-80.69356278	
18,033.00	88.81	151.29	11,308.34	-5,195.28	3,377.48	14,437,959.42	1,726,582.94	39.75579922	-80.69340890	
18,126.00	89.08	151.99	11,310.05	-5,277.11	3,421.65	14,437,877.59	1,726,627.11	39.75557409	-80.69325274	
18,220.00	88.64	150.94	11,311.92	-5,359.67	3,466.54	14,437,795.03	1,726,672.01	39.75534693	-80.69309401	
18,314.00	89.43	149.88	11,313.50	-5,441.40	3,512.95	14,437,713.30	1,726,718.41	39.75512205	-80.69292989	
18,407.00	88.81	149.88	11,314.93	-5,521.83	3,559.62	14,437,632.87	1,726,765.08	39.75490072	-80.69276484	
18,501.00	88.81	149.70	11,316.88	-5,603.05	3,606.90	14,437,551.65	1,726,812.36	39.75467723	-80.69259758	
18,596.00	89.08	150.23	11,318.63	-5,685.27	3,654.45	14,437,469.42	1,726,859.91	39.75445096	-80.69242943	
18,690.00	88.02	151.64	11,321.01	-5,767.41	3,700.10	14,437,387.29	1,726,905.56	39.75422497	-80.69226801	
18,784.00	88.37	152.34	11,323.97	-5,850.36	3,744.22	14,437,304.34	1,726,949.68	39.75399676	-80.69211204	
18,878.00	88.55	151.99	11,326.50	-5,933.45	3,788.09	14,437,221.25	1,726,993.55	39.75376814	-80.69195694	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek S-15HU (slot O)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek S-15HU (slot O)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Survey

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
18,972.00	88.81	152.17	11,328.66	-6,016.49	3,832.10	14,437,138.21	1,727,037.56	39.75353969	-80.69180140
19,066.00	88.11	151.29	11,331.19	-6,099.24	3,876.60	14,437,055.46	1,727,082.06	39.75331199	-80.69164407
19,160.00	88.37	151.11	11,334.08	-6,181.58	3,921.86	14,436,973.12	1,727,127.32	39.75308545	-80.69148403
19,254.00	88.81	151.29	11,336.39	-6,263.92	3,967.13	14,436,890.77	1,727,172.59	39.75285888	-80.69132397
19,348.00	89.25	151.81	11,337.98	-6,346.56	4,011.91	14,436,808.14	1,727,217.37	39.75263151	-80.69116568
19,442.00	87.76	150.23	11,340.43	-6,428.76	4,057.43	14,436,725.94	1,727,262.89	39.75240535	-80.69100472
19,536.00	87.93	149.88	11,343.97	-6,510.15	4,104.32	14,436,644.55	1,727,309.78	39.75218137	-80.69083889
19,630.00	88.11	150.06	11,347.22	-6,591.48	4,151.34	14,436,563.21	1,727,356.80	39.75195756	-80.69067262
19,724.00	88.02	150.06	11,350.39	-6,672.89	4,198.22	14,436,481.81	1,727,403.68	39.75173355	-80.69050679
19,818.00	88.64	149.18	11,353.13	-6,753.95	4,245.74	14,436,400.75	1,727,451.20	39.75151049	-80.69033873
19,912.00	89.08	149.00	11,355.00	-6,834.58	4,294.02	14,436,320.11	1,727,499.48	39.75128859	-80.69016796
20,005.00	88.99	148.65	11,356.57	-6,914.14	4,342.15	14,436,240.56	1,727,547.61	39.75106965	-80.68999768
20,100.00	89.16	148.47	11,358.10	-6,995.18	4,391.70	14,436,159.51	1,727,597.16	39.75084661	-80.68982240
20,193.00	89.34	148.47	11,359.32	-7,074.45	4,440.33	14,436,080.25	1,727,645.79	39.75062847	-80.68965036
20,286.00	89.60	148.12	11,360.18	-7,153.56	4,489.20	14,436,001.13	1,727,694.66	39.75041073	-80.68947745
20,380.00	89.60	148.30	11,360.83	-7,233.46	4,538.72	14,435,921.24	1,727,744.18	39.75019084	-80.68930226
20,474.00	89.43	149.88	11,361.63	-7,314.11	4,587.01	14,435,840.59	1,727,792.47	39.74996891	-80.68913147
20,567.00	89.43	149.35	11,362.55	-7,394.33	4,634.04	14,435,760.37	1,727,839.50	39.74974815	-80.68896511
20,661.00	89.96	149.70	11,363.05	-7,475.34	4,681.72	14,435,679.36	1,727,887.18	39.74952521	-80.68879651
20,756.00	90.13	149.35	11,362.98	-7,557.22	4,729.90	14,435,597.48	1,727,935.36	39.74929990	-80.68862610
20,849.00	90.13	148.83	11,362.77	-7,637.01	4,777.67	14,435,517.69	1,727,983.13	39.74908032	-80.68845713
20,943.00	89.69	148.65	11,362.92	-7,717.36	4,826.45	14,435,437.34	1,728,031.91	39.74885918	-80.68828458
20,978.00	89.60	148.47	11,363.13	-7,747.22	4,844.70	14,435,407.48	1,728,050.16	39.74877700	-80.68822000
Survey @ 20978.00 MD 11363.13 TVD									
21,035.00	89.60	148.47	11,363.53	-7,795.80	4,874.51	14,435,358.89	1,728,079.97	39.74864329	-80.68811456
Survey projected to 21035.00 MD 11363.53 TVD									

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
146.00	146.00	0.06	-0.10	MWD surveys
20,978.00	11,363.13	-7,747.22	4,844.70	Survey @ 20978.00 MD 11363.13 TVD
21,035.00	11,363.53	-7,795.80	4,874.51	Survey projected to 21035.00 MD 11363.53 TVD