



Well: Armstrong 1S-10 HU (slot L)  
 Site: Armstrong Pad  
 Project: Marshall County, West Virginia  
 Design: rev1

SECTION DETAILS

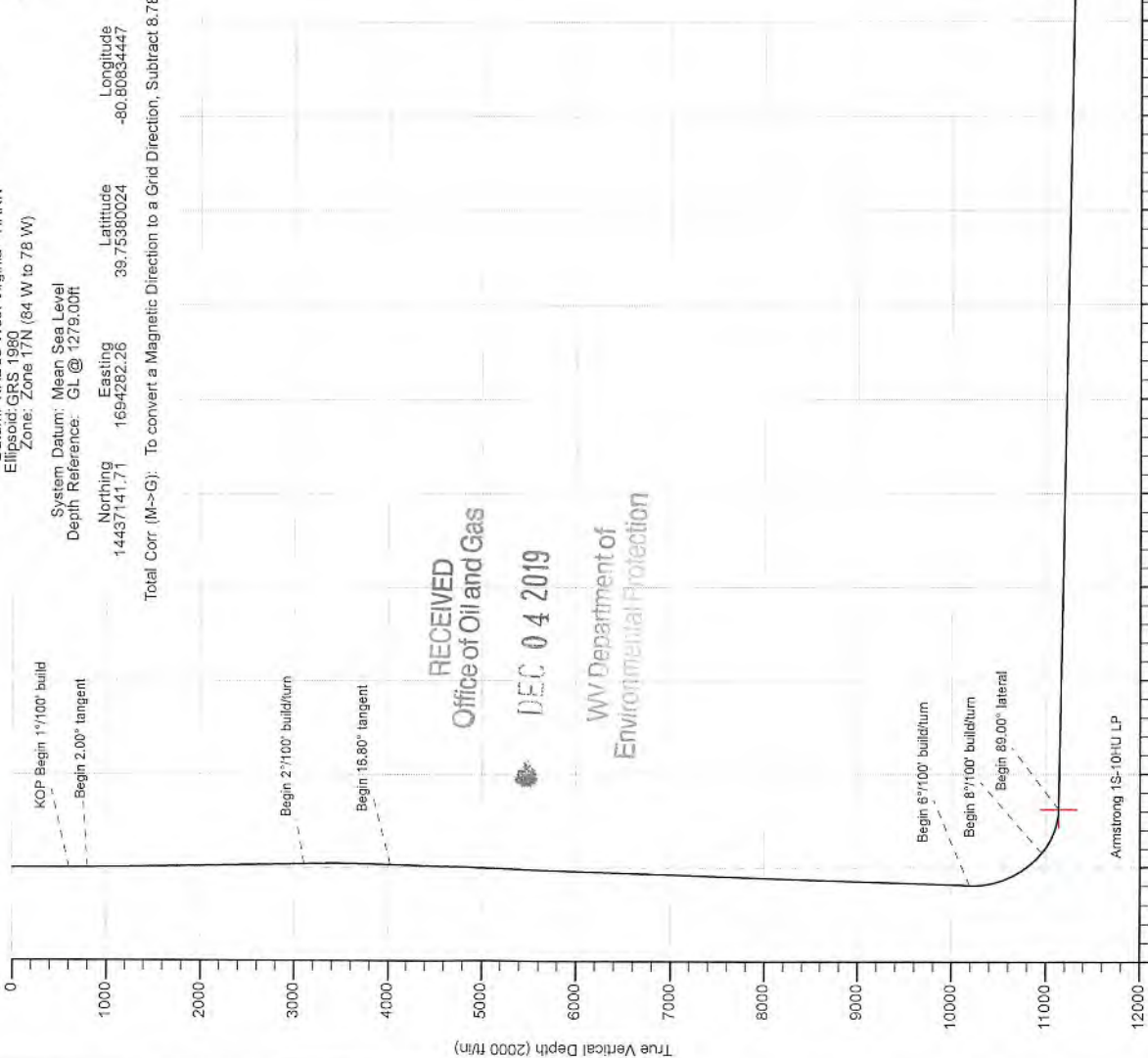
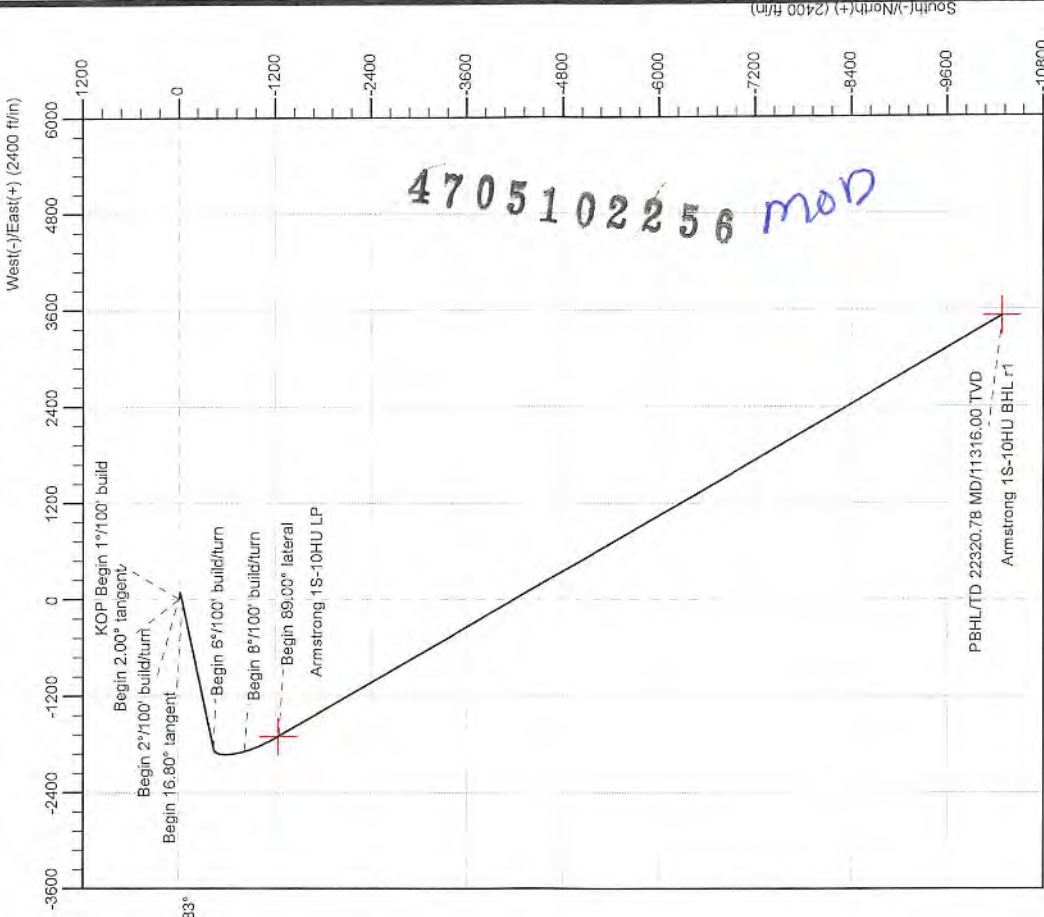
Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSEct	Annotation
1	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	
2	600.00	0.00	0.000	600.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 1'100' build
3	800.00	2.00	100.000	799.96	-0.61	3.44	1.00	100.000	1.69	Begin 2.00° tangent
4	3101.44	2.00	100.000	3100.00	-14.55	82.54	0.00	0.000	40.52	Begin 2'7100' build/turn
5	4034.86	16.80	257.950	4021.37	-45.82	-34.38	2.00	160.785	32.21	Begin 16.80° tangent
6	10480.60	50.00	163.640	10192.02	-434.75	-1856.34	0.00	0.000	-190.30	Begin 6'7100' build/turn
7	11367.64	89.00	150.000	10957.55	-815.27	-1889.34	8.00	-107.503	159.32	Begin 8'7100' build/turn
8	11879.24	88.00	150.000	11134.00	-1243.14	-1697.06	8.00	-21.096	626.08	Begin 89.00° lateral
9	22320.78	88.00	150.000	11316.00	-10284.36	-3522.99	0.00	0.000	0871.04	PBHL/TD 22320.78 MD/11316.00 TVD

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: GL @ 1279.00ft

Northing 14437141.71 Easting 1694282.26 Latitude 38.75380024 Longitude -80.80834447

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.783°



Azimuths to Grid North  
 True North: -0.12°  
 Magnetic North: -8.78°  
 Magnetic Field  
 Strength: 51992.3nT  
 Dip Angle: 66.82°  
 Date: 12/25/2018  
 Model: IGRF2015





Planning Report - Geographic

4705102256 mod

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-10 HU (slot L)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1279.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-10 HU (slot L)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev1		

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	Armstrong Pad				
Site Position:		Northing:	14,437,151.34 usft	Latitude:	39.75382662
From:	Lat/Long	Easting:	1,694,289.43 usft	Longitude:	-80.80831890
Position Uncertainty:	0.00 ft	Slot Radius:	13-3/16 "	Grid Convergence:	0.123 °

Well	Armstrong 1S-10 HU (slot L)					
Well Position	+N/-S	0.00 ft	Northing:	14,437,141.72 usft	Latitude:	39.75380024
	+E/-W	0.00 ft	Easting:	1,694,282.26 usft	Longitude:	-80.80834447
Position Uncertainty	0.00 ft	Wellhead Elevation:		Ground Level:	1,279.00 ft	

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	12/25/2018	-8.660	66.817	51,992.25057497

Design	rev1				
Audit Notes:					
Version:	Phase:	PLAN	Tie On Depth:	0.00	
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)	
	0.00	0.00	0.00	161.091	

Plan Survey Tool Program	Date	10/22/2019			
Depth From (ft)	Depth To (ft)	Survey (Wellbore)	Tool Name	Remarks	
1	0.00	22,320.78 rev1 (Original Hole)	MWD MWD - Standard		RECEIVED Office of Oil and Gas DEC 04 2019

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)	TFO (°)	Target
0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.000	
600.00	0.00	0.000	600.00	0.00	0.00	0.00	0.00	0.00	0.000	
800.00	2.00	100.000	799.96	-0.61	3.44	1.00	1.00	0.00	100.000	
3,101.44	2.00	100.000	3,100.00	-14.55	82.54	0.00	0.00	0.00	0.000	
4,034.85	16.80	257.950	4,021.37	-45.82	-34.38	2.00	1.59	16.92	160.185	
10,480.60	16.80	257.950	10,192.02	-434.75	-1,856.34	0.00	0.00	0.00	0.000	
11,367.64	50.00	163.640	10,957.55	-815.27	-1,888.34	6.00	3.74	-10.63	-107.503	
11,879.24	89.00	150.000	11,134.00	-1,243.14	-1,697.06	8.00	7.62	-2.67	-21.096	
22,320.78	89.00	150.000	11,316.00	-10,284.36	3,522.99	0.00	0.00	0.00	0.000	Armstrong 1S-10HU E



Planning Report - Geographic

4705102256 *mon*

Database: DB\_Aug1919\_v14  
 Company: Tug Hill Operating LLC  
 Project: Marshall County, West Virginia  
 Site: Armstrong Pad  
 Well: Armstrong 1S-10 HU (slot L)  
 Wellbore: Original Hole  
 Design: rev1

Local Co-ordinate Reference: Well Armstrong 1S-10 HU (slot L)  
 TVD Reference: GL @ 1279.00ft  
 MD Reference: GL @ 1279.00ft  
 North Reference: Grid  
 Survey Calculation Method: Minimum Curvature

RECEIVED  
 Office of Oil and Gas

DEC 04 2019

WV Department of  
 Environmental Protection

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
0.00	0.00	0.000	0.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
100.00	0.00	0.000	100.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
200.00	0.00	0.000	200.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
300.00	0.00	0.000	300.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
400.00	0.00	0.000	400.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
500.00	0.00	0.000	500.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
600.00	0.00	0.000	600.00	0.00	0.00	14,437,141.72	1,694,282.26	39.75380024	-80.80834447
<b>KOP Begin 1°/100' build</b>									
700.00	1.00	100.000	699.99	-0.15	0.86	14,437,141.57	1,694,283.12	39.75379982	-80.80834141
800.00	2.00	100.000	799.96	-0.61	3.44	14,437,141.11	1,694,285.70	39.75379856	-80.80833225
<b>Begin 2.00° tangent</b>									
900.00	2.00	100.000	899.90	-1.21	6.87	14,437,140.51	1,694,289.13	39.75379687	-80.80832002
1,000.00	2.00	100.000	999.84	-1.82	10.31	14,437,139.90	1,694,292.57	39.75379519	-80.80830780
1,100.00	2.00	100.000	1,099.78	-2.42	13.75	14,437,139.29	1,694,296.01	39.75379350	-80.80829557
1,200.00	2.00	100.000	1,199.72	-3.03	17.18	14,437,138.69	1,694,299.44	39.75379182	-80.80828335
1,300.00	2.00	100.000	1,299.65	-3.64	20.62	14,437,138.08	1,694,302.88	39.75379013	-80.80827113
1,400.00	2.00	100.000	1,399.59	-4.24	24.06	14,437,137.48	1,694,306.32	39.75378845	-80.80825890
1,500.00	2.00	100.000	1,499.53	-4.85	27.50	14,437,136.87	1,694,309.76	39.75378677	-80.80824668
1,600.00	2.00	100.000	1,599.47	-5.45	30.93	14,437,136.26	1,694,313.19	39.75378508	-80.80823445
1,700.00	2.00	100.000	1,699.41	-6.06	34.37	14,437,135.66	1,694,316.63	39.75378340	-80.80822223
1,800.00	2.00	100.000	1,799.35	-6.67	37.81	14,437,135.05	1,694,320.07	39.75378171	-80.80821001
1,900.00	2.00	100.000	1,899.29	-7.27	41.24	14,437,134.45	1,694,323.50	39.75378003	-80.80819778
2,000.00	2.00	100.000	1,999.23	-7.88	44.68	14,437,133.84	1,694,326.94	39.75377834	-80.80818556
2,100.00	2.00	100.000	2,099.17	-8.48	48.12	14,437,133.23	1,694,330.38	39.75377666	-80.80817333
2,200.00	2.00	100.000	2,199.11	-9.09	51.55	14,437,132.63	1,694,333.81	39.75377497	-80.80816111
2,300.00	2.00	100.000	2,299.05	-9.70	54.99	14,437,132.02	1,694,337.25	39.75377329	-80.80814889
2,400.00	2.00	100.000	2,398.98	-10.30	58.43	14,437,131.41	1,694,340.69	39.75377160	-80.80813666
2,500.00	2.00	100.000	2,498.92	-10.91	61.87	14,437,130.81	1,694,344.12	39.75376992	-80.80812444
2,600.00	2.00	100.000	2,598.86	-11.51	65.30	14,437,130.20	1,694,347.56	39.75376824	-80.80811221
2,700.00	2.00	100.000	2,698.80	-12.12	68.74	14,437,129.60	1,694,351.00	39.75376655	-80.80809999
2,800.00	2.00	100.000	2,798.74	-12.73	72.18	14,437,129.00	1,694,354.44	39.75376487	-80.80808777
2,900.00	2.00	100.000	2,898.68	-13.33	75.61	14,437,128.38	1,694,357.87	39.75376318	-80.80807554
3,000.00	2.00	100.000	2,998.62	-13.94	79.05	14,437,127.78	1,694,361.31	39.75376150	-80.80806332
3,100.00	2.00	100.000	3,098.56	-14.54	82.49	14,437,127.17	1,694,364.75	39.75375981	-80.80805109
3,101.44	2.00	100.000	3,100.00	-14.55	82.54	14,437,127.16	1,694,364.80	39.75375979	-80.80805092
<b>Begin 2°/100' build/turn</b>									
3,200.00	0.68	177.716	3,198.53	-15.44	84.25	14,437,126.28	1,694,366.51	39.75375734	-80.80804481
3,300.00	2.20	242.230	3,298.50	-16.93	82.58	14,437,124.79	1,694,364.84	39.75375326	-80.80805078
3,400.00	4.15	250.800	3,398.35	-19.01	77.47	14,437,122.71	1,694,359.73	39.75374758	-80.80806897
3,500.00	6.13	253.868	3,497.94	-21.68	68.93	14,437,120.04	1,694,351.19	39.75374029	-80.80809938
3,600.00	8.12	255.438	3,597.16	-24.94	56.97	14,437,116.78	1,694,339.23	39.75373141	-80.80814196
3,700.00	10.11	256.392	3,695.90	-28.78	41.60	14,437,112.94	1,694,323.86	39.75372095	-80.80819667
3,800.00	12.11	257.035	3,794.02	-33.20	22.85	14,437,108.52	1,694,305.11	39.75370893	-80.80826343
3,900.00	14.11	257.497	3,891.41	-38.19	0.73	14,437,103.53	1,694,282.99	39.75369535	-80.80834217
4,000.00	16.10	257.847	3,987.95	-43.75	-24.73	14,437,097.97	1,694,257.53	39.75368024	-80.80843278
4,034.85	16.80	257.950	4,021.37	-45.82	-34.38	14,437,095.90	1,694,247.88	39.75367461	-80.80846714
<b>Begin 16.80° tangent</b>									
4,100.00	16.80	257.950	4,083.74	-49.75	-52.79	14,437,091.97	1,694,229.47	39.75366392	-80.80853269
4,200.00	16.80	257.950	4,179.47	-55.78	-81.06	14,437,085.93	1,694,201.20	39.75364752	-80.80863330
4,300.00	16.80	257.950	4,275.20	-61.82	-109.33	14,437,079.90	1,694,172.93	39.75363111	-80.80873392
4,400.00	16.80	257.950	4,370.94	-67.85	-137.59	14,437,073.87	1,694,144.67	39.75361471	-80.80883454
4,500.00	16.80	257.950	4,466.67	-73.89	-165.86	14,437,067.83	1,694,116.40	39.75359830	-80.80893515
4,600.00	16.80	257.950	4,562.40	-79.92	-194.12	14,437,061.80	1,694,088.14	39.75358190	-80.80903577
4,700.00	16.80	257.950	4,658.13	-85.95	-222.39	14,437,055.76	1,694,059.87	39.75356549	-80.80913639



Database: DB\_Aug1919\_V14  
 Company: Tug Hill Operating LLC  
 Project: Marshall County, West Virginia  
 Site: Armstrong Pad  
 Well: Armstrong 1S-10 HU (slot L)  
 Wellbore: Original Hole  
 Design: rev1

Local Co-ordinate Reference:  
 TVD Reference:  
 MD Reference:  
 North Reference:  
 Survey Calculation Method:

Well Armstrong 1S-10 HU (slot L)  
 GL @ 1279.00ft  
 GL @ 1279.00ft  
 Grid  
 Minimum Curvature  
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Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
4,800.00	16.80	257.950	4,753.86	-91.99	-250.66	14,437,049.73	1,694,031.60	39.75354909	-80.80923700
4,900.00	16.80	257.950	4,849.60	-98.02	-278.92	14,437,043.70	1,694,003.34	39.75353268	-80.80933762
5,000.00	16.80	257.950	4,945.33	-104.05	-307.19	14,437,037.66	1,693,975.07	39.75351628	-80.80943824
5,100.00	16.80	257.950	5,041.06	-110.09	-335.45	14,437,031.63	1,693,946.81	39.75349987	-80.80953885
5,200.00	16.80	257.950	5,136.79	-116.12	-363.72	14,437,025.60	1,693,918.54	39.75348346	-80.80963947
5,300.00	16.80	257.950	5,232.52	-122.16	-391.99	14,437,019.56	1,693,890.27	39.75346706	-80.80974008
5,400.00	16.80	257.950	5,328.26	-128.19	-420.25	14,437,013.53	1,693,862.01	39.75345065	-80.80984070
5,500.00	16.80	257.950	5,423.99	-134.22	-448.52	14,437,007.49	1,693,833.74	39.75343425	-80.80994132
5,600.00	16.80	257.950	5,519.72	-140.26	-476.78	14,437,001.46	1,693,805.48	39.75341784	-80.81004193
5,700.00	16.80	257.950	5,615.45	-146.29	-505.05	14,436,995.43	1,693,777.21	39.75340143	-80.81014255
5,800.00	16.80	257.950	5,711.18	-152.33	-533.32	14,436,989.39	1,693,748.94	39.75338503	-80.81024316
5,900.00	16.80	257.950	5,806.92	-158.36	-561.58	14,436,983.36	1,693,720.68	39.75336862	-80.81034378
6,000.00	16.80	257.950	5,902.65	-164.39	-589.85	14,436,977.32	1,693,692.41	39.75335222	-80.81044439
6,100.00	16.80	257.950	5,998.38	-170.43	-618.11	14,436,971.29	1,693,664.15	39.75333581	-80.81054501
6,200.00	16.80	257.950	6,094.11	-176.46	-646.38	14,436,965.26	1,693,635.88	39.75331940	-80.81064563
6,300.00	16.80	257.950	6,189.84	-182.50	-674.65	14,436,959.22	1,693,607.61	39.75330300	-80.81074624
6,400.00	16.80	257.950	6,285.58	-188.53	-702.91	14,436,953.19	1,693,579.35	39.75328659	-80.81084686
6,500.00	16.80	257.950	6,381.31	-194.56	-731.18	14,436,947.15	1,693,551.08	39.75327018	-80.81094747
6,600.00	16.80	257.950	6,477.04	-200.60	-759.45	14,436,941.12	1,693,522.82	39.75325377	-80.81104809
6,700.00	16.80	257.950	6,572.77	-206.63	-787.71	14,436,935.09	1,693,494.55	39.75323737	-80.81114870
6,800.00	16.80	257.950	6,668.50	-212.66	-815.98	14,436,929.05	1,693,466.28	39.75322096	-80.81124932
6,900.00	16.80	257.950	6,764.24	-218.70	-844.24	14,436,923.02	1,693,438.02	39.75320455	-80.81134993
7,000.00	16.80	257.950	6,859.97	-224.73	-872.51	14,436,916.99	1,693,409.75	39.75318815	-80.81145055
7,100.00	16.80	257.950	6,955.70	-230.77	-900.78	14,436,910.95	1,693,381.49	39.75317174	-80.81155116
7,200.00	16.80	257.950	7,051.43	-236.80	-929.04	14,436,904.92	1,693,353.22	39.75315533	-80.81165178
7,300.00	16.80	257.950	7,147.16	-242.83	-957.31	14,436,898.88	1,693,324.95	39.75313892	-80.81175239
7,400.00	16.80	257.950	7,242.90	-248.87	-985.57	14,436,892.85	1,693,296.69	39.75312252	-80.81185301
7,500.00	16.80	257.950	7,338.63	-254.90	-1,013.84	14,436,886.82	1,693,268.42	39.75310611	-80.81195362
7,600.00	16.80	257.950	7,434.36	-260.94	-1,042.11	14,436,880.78	1,693,240.16	39.75308970	-80.81205424
7,700.00	16.80	257.950	7,530.09	-266.97	-1,070.37	14,436,874.75	1,693,211.89	39.75307329	-80.81215485
7,800.00	16.80	257.950	7,625.82	-273.00	-1,098.64	14,436,868.71	1,693,183.62	39.75305688	-80.81225547
7,900.00	16.80	257.950	7,721.56	-279.04	-1,126.90	14,436,862.68	1,693,155.36	39.75304048	-80.81235608
8,000.00	16.80	257.950	7,817.29	-285.07	-1,155.17	14,436,856.65	1,693,127.09	39.75302407	-80.81245670
8,100.00	16.80	257.950	7,913.02	-291.10	-1,183.44	14,436,850.61	1,693,098.83	39.75300766	-80.81255731
8,200.00	16.80	257.950	8,008.75	-297.14	-1,211.70	14,436,844.58	1,693,070.56	39.75299125	-80.81265793
8,300.00	16.80	257.950	8,104.48	-303.17	-1,239.97	14,436,838.55	1,693,042.29	39.75297484	-80.81275854
8,400.00	16.80	257.950	8,200.22	-309.21	-1,268.23	14,436,832.51	1,693,014.03	39.75295843	-80.81285916
8,500.00	16.80	257.950	8,295.95	-315.24	-1,296.50	14,436,826.48	1,692,985.76	39.75294202	-80.81295977
8,600.00	16.80	257.950	8,391.68	-321.27	-1,324.77	14,436,820.44	1,692,957.50	39.75292562	-80.81306039
8,700.00	16.80	257.950	8,487.41	-327.31	-1,353.03	14,436,814.41	1,692,929.23	39.75290921	-80.81316100
8,800.00	16.80	257.950	8,583.14	-333.34	-1,381.30	14,436,808.38	1,692,900.96	39.75289280	-80.81326161
8,900.00	16.80	257.950	8,678.88	-339.38	-1,409.56	14,436,802.34	1,692,872.70	39.75287639	-80.81336223
9,000.00	16.80	257.950	8,774.61	-345.41	-1,437.83	14,436,796.31	1,692,844.43	39.75285998	-80.81346284
9,100.00	16.80	257.950	8,870.34	-351.44	-1,466.10	14,436,790.27	1,692,816.17	39.75284357	-80.81356346
9,200.00	16.80	257.950	8,966.07	-357.48	-1,494.36	14,436,784.24	1,692,787.90	39.75282716	-80.81366407
9,300.00	16.80	257.950	9,061.81	-363.51	-1,522.63	14,436,778.21	1,692,759.63	39.75281075	-80.81376469
9,400.00	16.80	257.950	9,157.54	-369.55	-1,550.90	14,436,772.17	1,692,731.37	39.75279434	-80.81386530
9,500.00	16.80	257.950	9,253.27	-375.58	-1,579.16	14,436,766.14	1,692,703.10	39.75277793	-80.81396591
9,600.00	16.80	257.950	9,349.00	-381.61	-1,607.43	14,436,760.11	1,692,674.84	39.75276152	-80.81406653
9,700.00	16.80	257.950	9,444.73	-387.65	-1,635.69	14,436,754.07	1,692,646.57	39.75274511	-80.81416714
9,800.00	16.80	257.950	9,540.47	-393.68	-1,663.96	14,436,748.04	1,692,618.30	39.75272870	-80.81426776
9,900.00	16.80	257.950	9,636.20	-399.71	-1,692.23	14,436,742.00	1,692,590.04	39.75271229	-80.81436837
10,000.00	16.80	257.950	9,731.93	-405.75	-1,720.49	14,436,735.97	1,692,561.77	39.75269588	-80.81446898
10,100.00	16.80	257.950	9,827.66	-411.78	-1,748.76	14,436,729.94	1,692,533.51	39.75267947	-80.81456960
10,200.00	16.80	257.950	9,923.39	-417.82	-1,777.02	14,436,723.90	1,692,505.24	39.75266306	-80.81467021



4705102256 moy

Database: DB\_Aug1919\_v14  
 Company: Tug Hill Operating LLC  
 Project: Marshall County, West Virginia  
 Site: Armstrong Pad  
 Well: Armstrong 1S-10 HU (slot L)  
 Wellbore: Original Hole  
 Design: rev1

Local Co-ordinate Reference: Well Armstrong 1S-10 HU (slot L)  
 TVD Reference: GL @ 1279.00ft  
 MD Reference: GL @ 1279.00ft  
 North Reference: Grid  
 Survey Calculation Method: Minimum Curvature

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Planned Survey

WV Department of  
 Environmental Protection

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
10,300.00	16.80	257.950	10,019.13	-423.85	-1,805.29	14,436,717.87	1,692,476.97	39.75264665	-80.81477082
10,400.00	16.80	257.950	10,114.86	-429.88	-1,833.56	14,436,711.83	1,692,448.71	39.75263024	-80.81487144
10,480.60	16.80	257.950	10,192.02	-434.75	-1,856.34	14,436,706.97	1,692,425.92	39.75261702	-80.81495253
<b>Begin 6°/100' build/turn</b>									
10,500.00	16.49	254.036	10,210.61	-436.09	-1,861.73	14,436,705.63	1,692,420.54	39.75261336	-80.81497171
10,600.00	16.12	232.585	10,306.67	-448.44	-1,886.42	14,436,693.28	1,692,395.85	39.75257959	-80.81505965
10,700.00	17.83	212.774	10,402.39	-469.76	-1,905.75	14,436,671.95	1,692,376.52	39.75252113	-80.81512859
10,800.00	21.12	197.639	10,496.72	-499.84	-1,919.51	14,436,641.88	1,692,362.75	39.75243862	-80.81517777
10,900.00	25.39	186.892	10,588.61	-538.33	-1,927.55	14,436,603.39	1,692,354.71	39.75233296	-80.81520666
11,000.00	30.21	179.217	10,677.07	-584.81	-1,929.78	14,436,556.91	1,692,352.48	39.75220532	-80.81521493
11,100.00	35.37	173.541	10,761.13	-638.78	-1,926.18	14,436,502.94	1,692,356.09	39.75205708	-80.81520251
11,200.00	40.73	169.166	10,839.86	-699.64	-1,916.78	14,436,442.08	1,692,365.48	39.75188988	-80.81516952
11,300.00	46.23	165.661	10,912.40	-766.73	-1,901.69	14,436,374.99	1,692,380.57	39.75170555	-80.81511633
11,367.64	50.00	163.640	10,957.55	-815.27	-1,888.34	14,436,326.45	1,692,393.92	39.75157217	-80.81506919
<b>Begin 8°/100' build/turn</b>									
11,400.00	52.42	162.465	10,977.82	-839.39	-1,880.98	14,436,302.32	1,692,401.28	39.75150588	-80.81504319
11,500.00	59.97	159.258	11,033.43	-917.79	-1,853.67	14,436,223.93	1,692,428.59	39.75129043	-80.81494659
11,600.00	67.58	156.510	11,077.60	-1,000.79	-1,819.86	14,436,140.93	1,692,462.40	39.75106228	-80.81482691
11,700.00	75.23	154.050	11,109.47	-1,086.80	-1,780.22	14,436,054.92	1,692,502.04	39.75082587	-80.81468650
11,800.00	82.91	151.758	11,128.42	-1,174.12	-1,735.51	14,435,967.60	1,692,546.75	39.75058579	-80.81452808
11,879.24	89.00	150.000	11,134.00	-1,243.14	-1,697.06	14,435,898.58	1,692,585.20	39.75039604	-80.81439178
<b>Begin 89.00° lateral</b>									
11,900.00	89.00	150.000	11,134.37	-1,261.11	-1,686.68	14,435,880.61	1,692,595.58	39.75034661	-80.81435499
12,000.00	89.00	150.000	11,136.11	-1,347.70	-1,636.69	14,435,794.02	1,692,645.58	39.75010853	-80.81417776
12,100.00	89.00	150.000	11,137.85	-1,434.29	-1,586.69	14,435,707.43	1,692,695.57	39.74987045	-80.81400053
12,200.00	89.00	150.000	11,139.59	-1,520.88	-1,536.70	14,435,620.84	1,692,745.56	39.74963236	-80.81382331
12,300.00	89.00	150.000	11,141.34	-1,607.47	-1,486.71	14,435,534.25	1,692,795.55	39.74939428	-80.81364608
12,400.00	89.00	150.000	11,143.08	-1,694.06	-1,436.72	14,435,447.66	1,692,845.55	39.74915619	-80.81346886
12,500.00	89.00	150.000	11,144.82	-1,780.65	-1,386.72	14,435,361.07	1,692,895.54	39.74891811	-80.81329164
12,600.00	89.00	150.000	11,146.57	-1,867.24	-1,336.73	14,435,274.49	1,692,945.53	39.74868002	-80.81311442
12,700.00	89.00	150.000	11,148.31	-1,953.82	-1,286.74	14,435,187.90	1,692,995.53	39.74844194	-80.81293720
12,800.00	89.00	150.000	11,150.05	-2,040.41	-1,236.74	14,435,101.31	1,693,045.52	39.74820385	-80.81275998
12,900.00	89.00	150.000	11,151.80	-2,127.00	-1,186.75	14,435,014.72	1,693,095.51	39.74796577	-80.81258276
13,000.00	89.00	150.000	11,153.54	-2,213.59	-1,136.76	14,434,928.13	1,693,145.51	39.74772768	-80.81240555
13,100.00	89.00	150.000	11,155.28	-2,300.18	-1,086.76	14,434,841.54	1,693,195.50	39.74748960	-80.81222833
13,200.00	89.00	150.000	11,157.02	-2,386.77	-1,036.77	14,434,754.95	1,693,245.49	39.74725151	-80.81205112
13,300.00	89.00	150.000	11,158.77	-2,473.36	-986.78	14,434,668.36	1,693,295.48	39.74701342	-80.81187391
13,400.00	89.00	150.000	11,160.51	-2,559.95	-936.78	14,434,581.78	1,693,345.48	39.74677534	-80.81169670
13,500.00	89.00	150.000	11,162.25	-2,646.54	-886.79	14,434,495.19	1,693,395.47	39.74653725	-80.81151949
13,600.00	89.00	150.000	11,164.00	-2,733.13	-836.80	14,434,408.60	1,693,445.46	39.74629916	-80.81134228
13,700.00	89.00	150.000	11,165.74	-2,819.71	-786.80	14,434,322.01	1,693,495.46	39.74606107	-80.81116507
13,800.00	89.00	150.000	11,167.48	-2,906.30	-736.81	14,434,235.42	1,693,545.45	39.74582298	-80.81098787
13,900.00	89.00	150.000	11,169.23	-2,992.89	-686.82	14,434,148.83	1,693,595.44	39.74558490	-80.81081066
14,000.00	89.00	150.000	11,170.97	-3,079.48	-636.83	14,434,062.24	1,693,645.44	39.74534681	-80.81063346
14,100.00	89.00	150.000	11,172.71	-3,166.07	-586.83	14,433,975.65	1,693,695.43	39.74510872	-80.81045625
14,200.00	89.00	150.000	11,174.45	-3,252.66	-536.84	14,433,889.06	1,693,745.42	39.74487063	-80.81027905
14,300.00	89.00	150.000	11,176.20	-3,339.25	-486.85	14,433,802.48	1,693,795.41	39.74463254	-80.81010185
14,400.00	89.00	150.000	11,177.94	-3,425.84	-436.85	14,433,715.89	1,693,845.41	39.74439445	-80.80992465
14,500.00	89.00	150.000	11,179.68	-3,512.43	-386.86	14,433,629.30	1,693,895.40	39.74415636	-80.80974746
14,600.00	89.00	150.000	11,181.43	-3,599.02	-336.87	14,433,542.71	1,693,945.39	39.74391827	-80.80957026
14,700.00	89.00	150.000	11,183.17	-3,685.60	-286.87	14,433,456.12	1,693,995.39	39.74368018	-80.80939307
14,800.00	89.00	150.000	11,184.91	-3,772.19	-236.88	14,433,369.53	1,694,045.38	39.74344209	-80.80921587
14,900.00	89.00	150.000	11,186.66	-3,858.78	-186.89	14,433,282.94	1,694,095.37	39.74320400	-80.80903868
15,000.00	89.00	150.000	11,188.40	-3,945.37	-136.89	14,433,196.35	1,694,145.37	39.74296590	-80.80886149



Planning Report - Geographic

4705102256 map

Database: DB\_Aug1919\_v14  
 Company: Tug Hill Operating LLC  
 Project: Marshall County, West Virginia  
 Site: Armstrong Pad  
 Well: Armstrong 1S-10 HU (slot L)  
 Wellbore: Original Hole  
 Design: rev1

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 TVD Reference: GL @ 1279.00ft  
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 Survey Calculation Method: Minimum Curvature

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Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
15,100.00	89.00	150.000	11,190.14	-4,031.96	-86.90	14,433,109.77	1,694,195.36	39.74272781	-80.80868430
15,200.00	89.00	150.000	11,191.88	-4,118.55	-36.91	14,433,023.18	1,694,245.35	39.74248972	-80.80850711
15,300.00	89.00	150.000	11,193.63	-4,205.14	13.08	14,432,936.59	1,694,295.34	39.74225163	-80.80832992
15,400.00	89.00	150.000	11,195.37	-4,291.73	63.08	14,432,850.00	1,694,345.34	39.74201353	-80.80815273
15,500.00	89.00	150.000	11,197.11	-4,378.32	113.07	14,432,763.41	1,694,395.33	39.74177544	-80.80797555
15,600.00	89.00	150.000	11,198.86	-4,464.91	163.06	14,432,676.82	1,694,445.32	39.74153735	-80.80779836
15,700.00	89.00	150.000	11,200.60	-4,551.49	213.06	14,432,590.23	1,694,495.32	39.74129925	-80.80762118
15,800.00	89.00	150.000	11,202.34	-4,638.08	263.05	14,432,503.64	1,694,545.31	39.74106116	-80.80744400
15,900.00	89.00	150.000	11,204.09	-4,724.67	313.04	14,432,417.05	1,694,595.30	39.74082307	-80.80726682
16,000.00	89.00	150.000	11,205.83	-4,811.26	363.04	14,432,330.47	1,694,645.30	39.74058497	-80.80708964
16,100.00	89.00	150.000	11,207.57	-4,897.85	413.03	14,432,243.88	1,694,695.29	39.74034688	-80.80691246
16,200.00	89.00	150.000	11,209.31	-4,984.44	463.02	14,432,157.29	1,694,745.28	39.74010878	-80.80673528
16,300.00	89.00	150.000	11,211.06	-5,071.03	513.02	14,432,070.70	1,694,795.27	39.73987069	-80.80655811
16,400.00	89.00	150.000	11,212.80	-5,157.62	563.01	14,431,984.11	1,694,845.27	39.73963259	-80.80638093
16,500.00	89.00	150.000	11,214.54	-5,244.21	613.00	14,431,897.52	1,694,895.26	39.73939450	-80.80620376
16,600.00	89.00	150.000	11,216.29	-5,330.79	662.99	14,431,810.93	1,694,945.25	39.73915640	-80.80602659
16,700.00	89.00	150.000	11,218.03	-5,417.38	712.99	14,431,724.34	1,694,995.25	39.73891830	-80.80584942
16,800.00	89.00	150.000	11,219.77	-5,503.97	762.98	14,431,637.76	1,695,045.24	39.73868021	-80.80567225
16,900.00	89.00	150.000	11,221.52	-5,590.56	812.97	14,431,551.17	1,695,095.23	39.73844211	-80.80549508
17,000.00	89.00	150.000	11,223.26	-5,677.15	862.97	14,431,464.58	1,695,145.23	39.73820401	-80.80531791
17,100.00	89.00	150.000	11,225.00	-5,763.74	912.96	14,431,377.99	1,695,195.22	39.73796592	-80.80514075
17,200.00	89.00	150.000	11,226.74	-5,850.33	962.95	14,431,291.40	1,695,245.21	39.73772782	-80.80496358
17,300.00	89.00	150.000	11,228.49	-5,936.92	1,012.95	14,431,204.81	1,695,295.20	39.73748972	-80.80478642
17,400.00	89.00	150.000	11,230.23	-6,023.51	1,062.94	14,431,118.22	1,695,345.20	39.73725162	-80.80460926
17,500.00	89.00	150.000	11,231.97	-6,110.10	1,112.93	14,431,031.63	1,695,395.19	39.73701352	-80.80443210
17,600.00	89.00	150.000	11,233.72	-6,196.68	1,162.93	14,430,945.04	1,695,445.18	39.73677543	-80.80425494
17,700.00	89.00	150.000	11,235.46	-6,283.27	1,212.92	14,430,858.46	1,695,495.18	39.73653733	-80.80407778
17,800.00	89.00	150.000	11,237.20	-6,369.86	1,262.91	14,430,771.87	1,695,545.17	39.73629923	-80.80390062
17,900.00	89.00	150.000	11,238.95	-6,456.45	1,312.90	14,430,685.28	1,695,595.16	39.73606113	-80.80372346
18,000.00	89.00	150.000	11,240.69	-6,543.04	1,362.90	14,430,598.69	1,695,645.16	39.73582303	-80.80354631
18,100.00	89.00	150.000	11,242.43	-6,629.63	1,412.89	14,430,512.10	1,695,695.15	39.73558493	-80.80336915
18,200.00	89.00	150.000	11,244.17	-6,716.22	1,462.88	14,430,425.51	1,695,745.14	39.73534683	-80.80319200
18,300.00	89.00	150.000	11,245.92	-6,802.81	1,512.88	14,430,338.92	1,695,795.13	39.73510873	-80.80301485
18,400.00	89.00	150.000	11,247.66	-6,889.40	1,562.87	14,430,252.33	1,695,845.13	39.73487063	-80.80283770
18,500.00	89.00	150.000	11,249.40	-6,975.99	1,612.86	14,430,165.75	1,695,895.12	39.73463252	-80.80266055
18,600.00	89.00	150.000	11,251.15	-7,062.57	1,662.86	14,430,079.16	1,695,945.11	39.73439442	-80.80248340
18,700.00	89.00	150.000	11,252.89	-7,149.16	1,712.85	14,429,992.57	1,695,995.11	39.73415632	-80.80230626
18,800.00	89.00	150.000	11,254.63	-7,235.75	1,762.84	14,429,905.98	1,696,045.10	39.73391822	-80.80212911
18,900.00	89.00	150.000	11,256.38	-7,322.34	1,812.84	14,429,819.39	1,696,095.09	39.73368012	-80.80195197
19,000.00	89.00	150.000	11,258.12	-7,408.93	1,862.83	14,429,732.80	1,696,145.09	39.73344201	-80.80177483
19,100.00	89.00	150.000	11,259.86	-7,495.52	1,912.82	14,429,646.21	1,696,195.08	39.73320391	-80.80159768
19,200.00	89.00	150.000	11,261.60	-7,582.11	1,962.82	14,429,559.62	1,696,245.07	39.73296581	-80.80142054
19,300.00	89.00	150.000	11,263.35	-7,668.70	2,012.81	14,429,473.04	1,696,295.06	39.73272770	-80.80124340
19,400.00	89.00	150.000	11,265.09	-7,755.29	2,062.80	14,429,386.45	1,696,345.06	39.73248960	-80.80106627
19,500.00	89.00	150.000	11,266.83	-7,841.88	2,112.79	14,429,299.86	1,696,395.05	39.73225150	-80.80088913
19,600.00	89.00	150.000	11,268.58	-7,928.46	2,162.79	14,429,213.27	1,696,445.04	39.73201339	-80.80071199
19,700.00	89.00	150.000	11,270.32	-8,015.05	2,212.78	14,429,126.68	1,696,495.04	39.73177529	-80.80053486
19,800.00	89.00	150.000	11,272.06	-8,101.64	2,262.77	14,429,040.09	1,696,545.03	39.73153718	-80.80035773
19,900.00	89.00	150.000	11,273.81	-8,188.23	2,312.77	14,428,953.50	1,696,595.02	39.73129908	-80.80018059
20,000.00	89.00	150.000	11,275.55	-8,274.82	2,362.76	14,428,866.91	1,696,645.02	39.73106097	-80.80000346
20,100.00	89.00	150.000	11,277.29	-8,361.41	2,412.75	14,428,780.32	1,696,695.01	39.73082287	-80.79982633
20,200.00	89.00	150.000	11,279.03	-8,448.00	2,462.75	14,428,693.74	1,696,745.00	39.73058476	-80.79964921
20,300.00	89.00	150.000	11,280.78	-8,534.59	2,512.74	14,428,607.15	1,696,794.99	39.73034665	-80.79947208
20,400.00	89.00	150.000	11,282.52	-8,621.18	2,562.73	14,428,520.56	1,696,844.99	39.73010855	-80.79929495
20,500.00	89.00	150.000	11,284.26	-8,707.77	2,612.73	14,428,433.97	1,696,894.98	39.72987044	-80.79911783



Planning Report - Geographic

4705102256 mod

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-10 HU (slot L)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1279.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-10 HU (slot L)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev1		

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
20,600.00	89.00	150.000	11,286.01	-8,794.35	2,662.72	14,428,347.38	1,696,944.97	39.72963233	-80.79894071	
20,700.00	89.00	150.000	11,287.75	-8,880.94	2,712.71	14,428,260.79	1,696,994.97	39.72939423	-80.79876358	
20,800.00	89.00	150.000	11,289.49	-8,967.53	2,762.70	14,428,174.20	1,697,044.96	39.72915612	-80.79858646	
20,900.00	89.00	150.000	11,291.24	-9,054.12	2,812.70	14,428,087.61	1,697,094.95	39.72891801	-80.79840934	
21,000.00	89.00	150.000	11,292.98	-9,140.71	2,862.69	14,428,001.03	1,697,144.95	39.72867990	-80.79823222	
21,100.00	89.00	150.000	11,294.72	-9,227.30	2,912.68	14,427,914.44	1,697,194.94	39.72844179	-80.79805511	
21,200.00	89.00	150.000	11,296.47	-9,313.89	2,962.68	14,427,827.85	1,697,244.93	39.72820368	-80.79787799	
21,300.00	89.00	150.000	11,298.21	-9,400.48	3,012.67	14,427,741.26	1,697,294.92	39.72796558	-80.79770088	
21,400.00	89.00	150.000	11,299.95	-9,487.07	3,062.66	14,427,654.67	1,697,344.92	39.72772747	-80.79752376	
21,500.00	89.00	150.000	11,301.69	-9,573.66	3,112.66	14,427,568.08	1,697,394.91	39.72748936	-80.79734665	
21,600.00	89.00	150.000	11,303.44	-9,660.24	3,162.65	14,427,481.49	1,697,444.90	39.72725125	-80.79716954	
21,700.00	89.00	150.000	11,305.18	-9,746.83	3,212.64	14,427,394.90	1,697,494.90	39.72701314	-80.79699243	
21,800.00	89.00	150.000	11,306.92	-9,833.42	3,262.64	14,427,308.31	1,697,544.89	39.72677503	-80.79681532	
21,900.00	89.00	150.000	11,308.67	-9,920.01	3,312.63	14,427,221.73	1,697,594.88	39.72653692	-80.79663821	
22,000.00	89.00	150.000	11,310.41	-10,006.60	3,362.62	14,427,135.14	1,697,644.88	39.72629880	-80.79646111	
22,100.00	89.00	150.000	11,312.15	-10,093.19	3,412.61	14,427,048.55	1,697,694.87	39.72606069	-80.79628400	
22,200.00	89.00	150.000	11,313.90	-10,179.78	3,462.61	14,426,961.96	1,697,744.86	39.72582258	-80.79610690	
22,300.00	89.00	150.000	11,315.64	-10,266.37	3,512.60	14,426,875.37	1,697,794.85	39.72558447	-80.79592979	
22,320.78	89.00	150.000	11,316.00	-10,284.36	3,522.99	14,426,857.38	1,697,805.24	39.72553500	-80.79589300	

PBHL/TD 22320.78 MD/11316.00 TVD

Design Targets										
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (usft)	Easting (usft)	Latitude	Longitude	
Armstrong 1S-10HU LP - hit/miss target - Shape - Point	0.00	0.000	11,134.00	-1,243.04	-1,697.03	14,435,898.68	1,692,585.24	39.75039629	-80.81439166	
- plan misses target center by 0.08ft at 11879.18ft MD (11134.00 TVD, -1243.08 N, -1697.09 E)										
Armstrong 1S-10HU BH - plan hits target center - Point	0.00	0.000	11,316.00	-10,284.36	3,522.99	14,426,857.38	1,697,805.24	39.72553500	-80.79589300	

Plan Annotations					
Measured Depth (ft)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Comment	
600.00	600.00	0.00	0.00	KOP Begin 1°/100' build	
800.00	799.96	-0.61	3.44	Begin 2.00° tangent	
3,101.44	3,100.00	-14.55	82.54	Begin 2°/100' build/turn	
4,034.85	4,021.37	-45.82	-34.38	Begin 16.80° tangent	
10,480.60	10,192.02	-434.75	-1,856.34	Begin 6°/100' build/turn	
11,367.64	10,957.55	-815.27	-1,888.34	Begin 8°/100' build/turn	
11,879.24	11,134.00	-1,243.14	-1,697.06	Begin 89.00° lateral	
22,320.78	11,316.00	-10,284.36	3,522.99	PBHL/TD 22320.78 MD/11316.00 TVD	

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