



Well: Armstrong 1S-11 HU (slot M)
 Site: Armstrong Pad
 Project: Marshall County, West Virginia
 Design: rev1

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSEct	Amolition
1	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.000	0.00	
2	400.00	0.00	0.000	400.00	0.00	0.00	0.00	0.000	0.00	KOP Begin 1°/100' build
3	600.00	2.00	90.000	599.96	0.00	3.49	1.00	90.000	1.50	Begin 2.00° tangent
4	4002.11	0.00	90.000	4000.00	0.00	122.22	1.00	0.000	52.49	Begin 1°/100' drop
5	4202.11	0.00	90.000	4199.96	0.00	125.71	1.00	180.000	53.99	Begin vertical hold
6	6002.15	0.00	90.000	6000.00	0.00	125.71	1.00	90.000	53.99	Begin 2°/100' build
7	6724.89	14.45	278.578	6715.10	13.53	36.04	2.00	278.578	3.26	Begin 14.45° tangent
8	10247.05	14.45	278.578	10125.76	144.67	-833.31	0.00	0.000	-498.54	Begin 6°/100' build/turn
9	11214.28	50.00	159.470	10979.17	-215.61	-821.75	6.00	-127.915	-168.22	Begin 8°/100' build/turn
10	11713.49	89.00	150.000	11151.00	-827.62	-621.74	8.00	-14.849	299.76	Begin 89.00° lateral
11	22155.03	89.00	150.000	11334.00	-8688.63	-4598.29	0.00	0.000	0706.57	PBHL/TD 22155.03 MD/11334.00 TVD

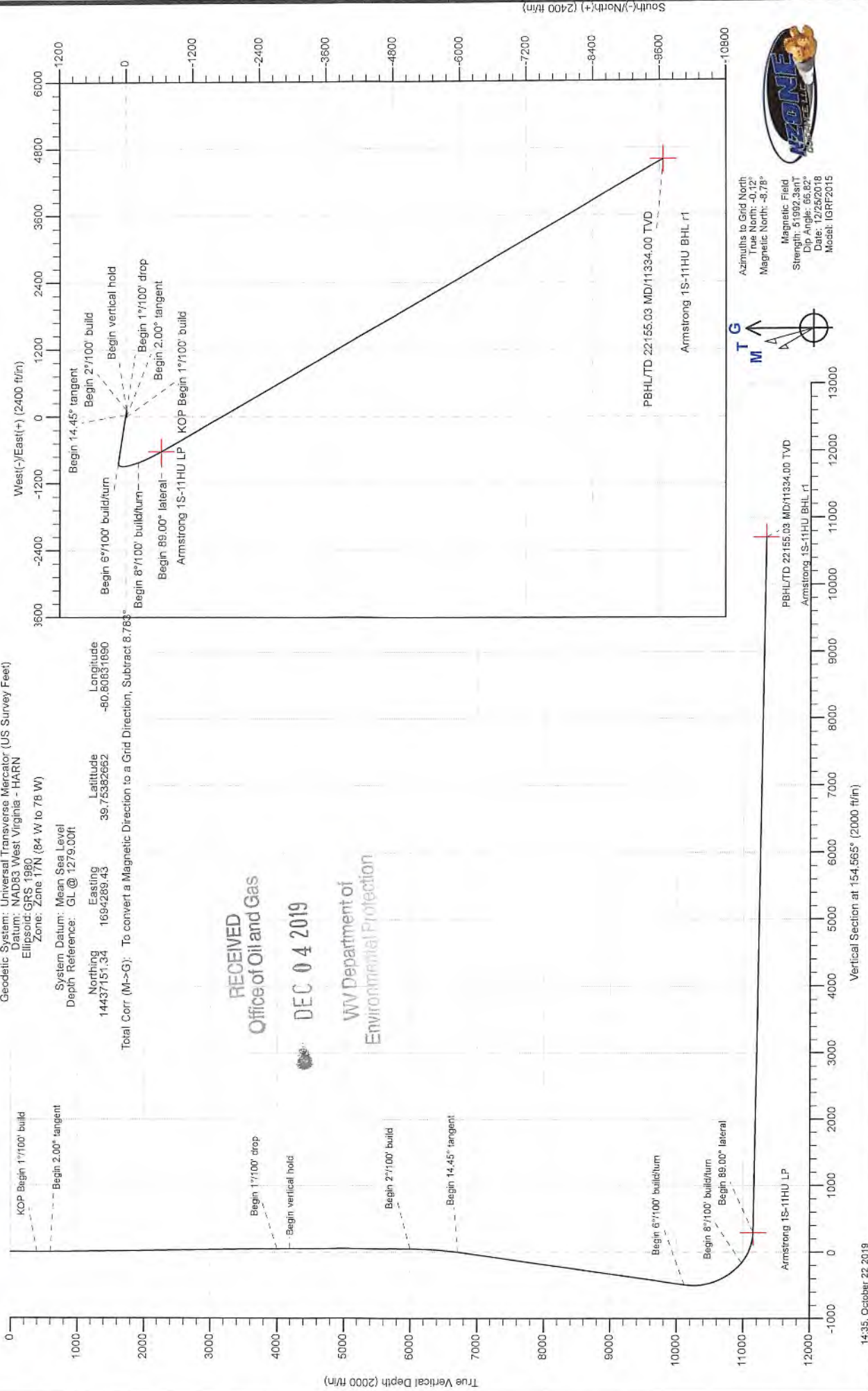
Geodetic System: Universal Transverse Mercator (US Survey Feet)

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: 14437151.34
 Easting: 1694289.43
 Latitude: 39.75382652
 Longitude: -80.60631890

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



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Azimuths to Grid North
 True North: -0.12°
 Magnetic North: -8.78°
 Magnetic Field
 Strength: 51992.3nT
 Dip Angle: 66.82°
 Date: 12/26/2018
 Model: IGRF2015



PBHL/TD 22155.03 MD/11334.00 TVD
 Armstrong 1S-11HU BHL r1
 Vertical Section at 154.565° (2000 ft/m)



4705102257 MOD

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-11 HU (slot M)
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-11 HU (slot M)	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-11 HU (slot M)					
Well Position	+N/-S	0.00 ft	Northing:	14,437,151.34 usft	Latitude:	39.75382662
	+E/-W	0.00 ft	Easting:	1,694,289.43 usft	Longitude:	-80.80831890
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	51,992.26114215

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	154.565	

Plan Survey Tool Program	Date	10/22/2019			
Depth From (ft)	Depth To (ft)	Survey (Wellbore)	Tool Name	Remarks	
1	0.00	22,155.03 rev1 (Original Hole)	MWD MWD - Standard		

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Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-11 HU (slot M)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev1		

Plan Sections										
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	
400.00	0.00	0.000	400.00	0.00	0.00	0.00	0.00	0.00	0.000	
600.00	2.00	90.000	599.96	0.00	3.49	1.00	1.00	0.00	90.000	
4,002.11	2.00	90.000	4,000.00	0.00	122.22	0.00	0.00	0.00	0.000	
4,202.11	0.00	90.000	4,199.96	0.00	125.71	1.00	-1.00	0.00	180.000	
6,002.15	0.00	90.000	6,000.00	0.00	125.71	0.00	0.00	0.00	90.000	
6,724.89	14.45	278.578	6,715.10	13.53	36.04	2.00	2.00	-23.72	278.578	
10,247.05	14.45	278.578	10,125.76	144.67	-833.31	0.00	0.00	0.00	0.000	
11,214.28	50.00	159.470	10,979.17	-215.61	-821.75	6.00	3.67	-12.31	-127.915	
11,713.49	89.00	150.000	11,151.00	-627.62	-621.74	8.00	7.81	-1.90	-14.849	
22,155.03	89.00	150.000	11,334.00	-9,668.83	4,598.29	0.00	0.00	0.00	0.000	Armstrong 1S-11HU E

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Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-11 HU (slot M)	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	
0.00	0.00	0.000	0.00	0.00	0.00	14,437,151.34	1,694,289.43	39.75382662	-80.80831890	
100.00	0.00	0.000	100.00	0.00	0.00	14,437,151.34	1,694,289.43	39.75382662	-80.80831890	
200.00	0.00	0.000	200.00	0.00	0.00	14,437,151.34	1,694,289.43	39.75382662	-80.80831890	
300.00	0.00	0.000	300.00	0.00	0.00	14,437,151.34	1,694,289.43	39.75382662	-80.80831890	
400.00	0.00	0.000	400.00	0.00	0.00	14,437,151.34	1,694,289.43	39.75382662	-80.80831890	
KOP Begin 1°/100' build										
500.00	1.00	90.000	499.99	0.00	0.87	14,437,151.34	1,694,290.30	39.75382662	-80.80831580	
600.00	2.00	90.000	599.96	0.00	3.49	14,437,151.34	1,694,292.92	39.75382660	-80.80830648	
Begin 2.00° tangent										
700.00	2.00	90.000	699.90	0.00	6.98	14,437,151.34	1,694,296.41	39.75382658	-80.80829407	
800.00	2.00	90.000	799.84	0.00	10.47	14,437,151.34	1,694,299.90	39.75382656	-80.80828165	
900.00	2.00	90.000	899.78	0.00	13.96	14,437,151.34	1,694,303.39	39.75382654	-80.80826923	
1,000.00	2.00	90.000	999.72	0.00	17.45	14,437,151.34	1,694,306.88	39.75382652	-80.80825681	
1,100.00	2.00	90.000	1,099.65	0.00	20.94	14,437,151.34	1,694,310.37	39.75382650	-80.80824440	
1,200.00	2.00	90.000	1,199.59	0.00	24.43	14,437,151.34	1,694,313.86	39.75382648	-80.80823198	
1,300.00	2.00	90.000	1,299.53	0.00	27.92	14,437,151.34	1,694,317.35	39.75382646	-80.80821956	
1,400.00	2.00	90.000	1,399.47	0.00	31.41	14,437,151.34	1,694,320.84	39.75382644	-80.80820714	
1,500.00	2.00	90.000	1,499.41	0.00	34.90	14,437,151.34	1,694,324.33	39.75382642	-80.80819473	
1,600.00	2.00	90.000	1,599.35	0.00	38.39	14,437,151.34	1,694,327.82	39.75382640	-80.80818231	
1,700.00	2.00	90.000	1,699.29	0.00	41.88	14,437,151.34	1,694,331.31	39.75382638	-80.80816989	
1,800.00	2.00	90.000	1,799.23	0.00	45.37	14,437,151.34	1,694,334.80	39.75382636	-80.80815748	
1,900.00	2.00	90.000	1,899.17	0.00	48.86	14,437,151.34	1,694,338.29	39.75382634	-80.80814506	
2,000.00	2.00	90.000	1,999.11	0.00	52.35	14,437,151.34	1,694,341.78	39.75382631	-80.80813264	
2,100.00	2.00	90.000	2,099.05	0.00	55.84	14,437,151.34	1,694,345.27	39.75382629	-80.80812022	
2,200.00	2.00	90.000	2,198.98	0.00	59.33	14,437,151.34	1,694,348.76	39.75382627	-80.80810781	
2,300.00	2.00	90.000	2,298.92	0.00	62.82	14,437,151.34	1,694,352.25	39.75382625	-80.80809539	
2,400.00	2.00	90.000	2,398.86	0.00	66.31	14,437,151.34	1,694,355.74	39.75382623	-80.80808297	
2,500.00	2.00	90.000	2,498.80	0.00	69.80	14,437,151.34	1,694,359.23	39.75382621	-80.80807055	
2,600.00	2.00	90.000	2,598.74	0.00	73.29	14,437,151.34	1,694,362.72	39.75382619	-80.80805814	
2,700.00	2.00	90.000	2,698.68	0.00	76.78	14,437,151.34	1,694,366.21	39.75382617	-80.80804572	
2,800.00	2.00	90.000	2,798.62	0.00	80.27	14,437,151.34	1,694,369.70	39.75382615	-80.80803330	
2,900.00	2.00	90.000	2,898.56	0.00	83.76	14,437,151.34	1,694,373.19	39.75382613	-80.80802089	
3,000.00	2.00	90.000	2,998.50	0.00	87.25	14,437,151.34	1,694,376.67	39.75382611	-80.80800847	
3,100.00	2.00	90.000	3,098.44	0.00	90.74	14,437,151.34	1,694,380.16	39.75382609	-80.80799605	
3,200.00	2.00	90.000	3,198.38	0.00	94.23	14,437,151.34	1,694,383.65	39.75382607	-80.80798363	
3,300.00	2.00	90.000	3,298.31	0.00	97.72	14,437,151.34	1,694,387.14	39.75382605	-80.80797122	
3,400.00	2.00	90.000	3,398.25	0.00	101.21	14,437,151.34	1,694,390.63	39.75382603	-80.80795880	
3,500.00	2.00	90.000	3,498.19	0.00	104.70	14,437,151.34	1,694,394.12	39.75382601	-80.80794638	
3,600.00	2.00	90.000	3,598.13	0.00	108.19	14,437,151.34	1,694,397.61	39.75382599	-80.80793396	
3,700.00	2.00	90.000	3,698.07	0.00	111.68	14,437,151.34	1,694,401.10	39.75382596	-80.80792155	
3,800.00	2.00	90.000	3,798.01	0.00	115.17	14,437,151.34	1,694,404.59	39.75382594	-80.80790913	
3,900.00	2.00	90.000	3,897.95	0.00	118.66	14,437,151.34	1,694,408.08	39.75382592	-80.80789671	
4,000.00	2.00	90.000	3,997.89	0.00	122.15	14,437,151.34	1,694,411.57	39.75382590	-80.80788430	
4,002.11	2.00	90.000	4,000.00	0.00	122.22	14,437,151.34	1,694,411.65	39.75382590	-80.80788403	
Begin 1°/100' drop										
4,100.00	1.02	90.000	4,097.85	0.00	124.80	14,437,151.34	1,694,414.23	39.75382589	-80.80787485	
4,200.00	0.02	90.000	4,197.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787162	
4,202.11	0.00	90.000	4,199.96	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
Begin vertical hold										
4,300.00	0.00	0.000	4,297.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
4,400.00	0.00	0.000	4,397.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
4,500.00	0.00	90.000	4,497.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
4,600.00	0.00	90.000	4,597.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
4,700.00	0.00	0.000	4,697.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	

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Planning Report - Geographic

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Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-11 HU (slot M)	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	
4,800.00	0.00	0.000	4,797.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
4,900.00	0.00	0.000	4,897.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,000.00	0.00	90.000	4,997.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,100.00	0.00	0.000	5,097.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,200.00	0.00	0.000	5,197.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,300.00	0.00	0.000	5,297.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,400.00	0.00	90.000	5,397.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,500.00	0.00	90.000	5,497.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,600.00	0.00	0.000	5,597.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,700.00	0.00	0.000	5,697.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,800.00	0.00	0.000	5,797.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
5,900.00	0.00	0.000	5,897.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
6,000.00	0.00	90.000	5,997.85	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
6,002.15	0.00	90.000	6,000.00	0.00	125.71	14,437,151.34	1,694,415.14	39.75382588	-80.80787161	
Begin 2°/100' build										
6,100.00	1.96	278.578	6,097.83	0.25	124.06	14,437,151.59	1,694,413.49	39.75382658	-80.80787749	
6,200.00	3.96	278.578	6,197.69	1.02	118.96	14,437,152.36	1,694,408.39	39.75382872	-80.80789563	
6,300.00	5.96	278.578	6,297.31	2.31	110.42	14,437,153.65	1,694,399.84	39.75383231	-80.80792602	
6,400.00	7.96	278.578	6,396.57	4.11	98.44	14,437,155.45	1,694,387.87	39.75383734	-80.80796862	
6,500.00	9.96	278.578	6,495.34	6.44	83.05	14,437,157.77	1,694,372.47	39.75384381	-80.80802337	
6,600.00	11.96	278.578	6,593.52	9.27	64.25	14,437,160.61	1,694,353.68	39.75385170	-80.80809022	
6,700.00	13.96	278.578	6,690.97	12.62	42.08	14,437,163.95	1,694,331.51	39.75386102	-80.80816907	
6,724.89	14.45	278.578	6,715.10	13.53	36.04	14,437,164.86	1,694,325.47	39.75386356	-80.80819056	
Begin 14.45° tangent										
6,800.00	14.45	278.578	6,787.83	16.32	17.50	14,437,167.66	1,694,306.93	39.75387135	-80.80825650	
6,900.00	14.45	278.578	6,884.66	20.05	-7.18	14,437,171.38	1,694,282.25	39.75388172	-80.80834429	
7,000.00	14.45	278.578	6,981.50	23.77	-31.86	14,437,175.11	1,694,257.57	39.75389209	-80.80843208	
7,100.00	14.45	278.578	7,078.33	27.49	-56.54	14,437,178.83	1,694,232.88	39.75390246	-80.80851987	
7,200.00	14.45	278.578	7,175.16	31.22	-81.23	14,437,182.55	1,694,208.20	39.75391283	-80.80860767	
7,300.00	14.45	278.578	7,272.00	34.94	-105.91	14,437,186.28	1,694,183.52	39.75392320	-80.80869546	
7,400.00	14.45	278.578	7,368.83	38.66	-130.59	14,437,190.00	1,694,158.84	39.75393357	-80.80878325	
7,500.00	14.45	278.578	7,465.67	42.39	-155.27	14,437,193.72	1,694,134.15	39.75394394	-80.80887104	
7,600.00	14.45	278.578	7,562.50	46.11	-179.96	14,437,197.45	1,694,109.47	39.75395431	-80.80895883	
7,700.00	14.45	278.578	7,659.34	49.83	-204.64	14,437,201.17	1,694,084.79	39.75396468	-80.80904663	
7,800.00	14.45	278.578	7,756.17	53.56	-229.32	14,437,204.89	1,694,060.11	39.75397505	-80.80913442	
7,900.00	14.45	278.578	7,853.01	57.28	-254.00	14,437,208.62	1,694,035.42	39.75398541	-80.80922221	
8,000.00	14.45	278.578	7,949.84	61.00	-278.68	14,437,212.34	1,694,010.74	39.75399578	-80.80931000	
8,100.00	14.45	278.578	8,046.67	64.73	-303.37	14,437,216.06	1,693,986.06	39.75400615	-80.80939779	
8,200.00	14.45	278.578	8,143.51	68.45	-328.05	14,437,219.79	1,693,961.38	39.75401652	-80.80948559	
8,300.00	14.45	278.578	8,240.34	72.17	-352.73	14,437,223.51	1,693,936.69	39.75402689	-80.80957338	
8,400.00	14.45	278.578	8,337.18	75.90	-377.41	14,437,227.23	1,693,912.01	39.75403726	-80.80966117	
8,500.00	14.45	278.578	8,434.01	79.62	-402.10	14,437,230.96	1,693,887.33	39.75404763	-80.80974896	
8,600.00	14.45	278.578	8,530.85	83.34	-426.78	14,437,234.68	1,693,862.65	39.75405800	-80.80983675	
8,700.00	14.45	278.578	8,627.68	87.06	-451.46	14,437,238.40	1,693,837.97	39.75406837	-80.80992455	
8,800.00	14.45	278.578	8,724.52	90.79	-476.14	14,437,242.13	1,693,813.28	39.75407874	-80.81001234	
8,900.00	14.45	278.578	8,821.35	94.51	-500.83	14,437,245.85	1,693,788.60	39.75408911	-80.81010013	
9,000.00	14.45	278.578	8,918.19	98.23	-525.51	14,437,249.57	1,693,763.92	39.75409948	-80.81018792	
9,100.00	14.45	278.578	9,015.02	101.96	-550.19	14,437,253.30	1,693,739.24	39.75410984	-80.81027572	
9,200.00	14.45	278.578	9,111.85	105.68	-574.87	14,437,257.02	1,693,714.55	39.75412021	-80.81036351	
9,300.00	14.45	278.578	9,208.69	109.40	-599.56	14,437,260.74	1,693,689.87	39.75413058	-80.81045130	
9,400.00	14.45	278.578	9,305.52	113.13	-624.24	14,437,264.47	1,693,665.19	39.75414095	-80.81053909	
9,500.00	14.45	278.578	9,402.36	116.85	-648.92	14,437,268.19	1,693,640.51	39.75415132	-80.81062689	
9,600.00	14.45	278.578	9,499.19	120.57	-673.60	14,437,271.91	1,693,615.82	39.75416169	-80.81071468	
9,700.00	14.45	278.578	9,596.03	124.30	-698.29	14,437,275.64	1,693,591.14	39.75417205	-80.81080247	



Planning Report - Geographic

4705102257 MOD

Database: DB_Aug1919_v14
 Company: Tug Hill Operating LLC
 Project: Marshall County, West Virginia
 Site: Armstrong Pad
 Well: Armstrong 1S-11 HU (slot M)
 Wellbore: Original Hole
 Design: rev1

Local Co-ordinate Reference: Well Armstrong 1S-11 HU (slot M)
 TVD Reference: GL @ 1279.00ft
 MD Reference: GL @ 1279.00ft
 North Reference: Grid
 Survey Calculation Method: Minimum Curvature

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 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
9,800.00	14.45	278.578	9,692.86	128.02	-722.97	14,437,279.36	1,693,566.46	39.75418242	-80.81089026
9,900.00	14.45	278.578	9,789.70	131.74	-747.65	14,437,283.08	1,693,541.78	39.75419279	-80.81097806
10,000.00	14.45	278.578	9,886.53	135.47	-772.33	14,437,286.81	1,693,517.10	39.75420316	-80.81106585
10,100.00	14.45	278.578	9,983.36	139.19	-797.01	14,437,290.53	1,693,492.41	39.75421353	-80.81115364
10,200.00	14.45	278.578	10,080.20	142.91	-821.70	14,437,294.25	1,693,467.73	39.75422390	-80.81124143
10,247.05	14.45	278.578	10,125.76	144.67	-833.31	14,437,296.00	1,693,456.12	39.75422877	-80.81128275
Begin 6°/100' build/turn									
10,300.00	12.75	267.149	10,177.23	145.36	-845.68	14,437,296.70	1,693,443.75	39.75423076	-80.81132676
10,400.00	11.36	238.874	10,275.11	139.72	-865.15	14,437,291.05	1,693,424.28	39.75421537	-80.81139606
10,500.00	12.91	210.979	10,372.96	125.04	-879.34	14,437,276.37	1,693,410.09	39.75417513	-80.81144666
10,600.00	16.59	192.153	10,469.70	101.48	-888.10	14,437,252.82	1,693,401.32	39.75411049	-80.81147802
10,700.00	21.33	180.723	10,564.28	69.31	-891.34	14,437,220.65	1,693,398.09	39.75402215	-80.81148978
10,800.00	26.56	173.453	10,655.66	28.87	-889.02	14,437,180.21	1,693,400.41	39.75391109	-80.81148182
10,900.00	32.05	168.477	10,742.84	-19.39	-881.16	14,437,131.95	1,693,408.27	39.75377851	-80.81145423
11,000.00	37.68	164.839	10,824.86	-74.94	-867.86	14,437,076.40	1,693,421.57	39.75362587	-80.81140730
11,100.00	43.40	162.030	10,900.83	-137.18	-849.25	14,437,014.16	1,693,440.18	39.75345484	-80.81134155
11,200.00	49.17	159.761	10,969.91	-205.42	-825.54	14,436,945.92	1,693,463.89	39.75326730	-80.81125771
11,214.28	50.00	159.470	10,979.17	-215.61	-821.75	14,436,935.73	1,693,467.68	39.75323929	-80.81124431
Begin 8°/100' build/turn									
11,300.00	56.65	157.371	11,030.34	-279.48	-796.43	14,436,871.86	1,693,493.00	39.75306374	-80.81115471
11,400.00	64.44	155.293	11,079.48	-359.13	-761.45	14,436,792.20	1,693,527.98	39.75284478	-80.81103084
11,500.00	72.26	153.471	11,116.35	-442.86	-721.26	14,436,708.48	1,693,568.17	39.75261462	-80.81088848
11,600.00	80.10	151.802	11,140.22	-529.01	-676.64	14,436,622.33	1,693,612.78	39.75237775	-80.81073038
11,700.00	87.94	150.212	11,150.64	-615.93	-628.47	14,436,535.41	1,693,660.96	39.75213877	-80.81055963
11,713.49	89.00	150.000	11,151.00	-627.62	-621.75	14,436,523.72	1,693,667.68	39.75210663	-80.81053580
Begin 89.00° lateral									
11,800.00	89.00	150.000	11,152.52	-702.53	-578.50	14,436,448.81	1,693,710.93	39.75190066	-80.81038249
11,900.00	89.00	150.000	11,154.27	-789.12	-528.50	14,436,362.22	1,693,760.92	39.75166257	-80.81020527
12,000.00	89.00	150.000	11,156.02	-875.71	-478.51	14,436,275.63	1,693,810.92	39.75142448	-80.81002805
12,100.00	89.00	150.000	11,157.78	-962.30	-428.52	14,436,189.05	1,693,860.91	39.75118639	-80.80985084
12,200.00	89.00	150.000	11,159.53	-1,048.88	-378.53	14,436,102.46	1,693,910.90	39.75094830	-80.80967363
12,300.00	89.00	150.000	11,161.28	-1,135.47	-328.53	14,436,015.87	1,693,960.89	39.75071021	-80.80949641
12,400.00	89.00	150.000	11,163.03	-1,222.06	-278.54	14,435,929.28	1,694,010.89	39.75047212	-80.80931920
12,500.00	89.00	150.000	11,164.79	-1,308.65	-228.55	14,435,842.69	1,694,060.88	39.75023403	-80.80914199
12,600.00	89.00	150.000	11,166.54	-1,395.24	-178.55	14,435,756.10	1,694,110.87	39.74999594	-80.80896478
12,700.00	89.00	150.000	11,168.29	-1,481.83	-128.56	14,435,669.51	1,694,160.87	39.74975785	-80.80878757
12,800.00	89.00	150.000	11,170.04	-1,568.42	-78.57	14,435,582.92	1,694,210.86	39.74951975	-80.80861037
12,900.00	89.00	150.000	11,171.80	-1,655.01	-28.57	14,435,496.34	1,694,260.85	39.74928166	-80.80843316
13,000.00	89.00	150.000	11,173.55	-1,741.59	21.42	14,435,409.75	1,694,310.84	39.74904357	-80.80825596
13,100.00	89.00	150.000	11,175.30	-1,828.18	71.41	14,435,323.16	1,694,360.84	39.74880548	-80.80807875
13,200.00	89.00	150.000	11,177.05	-1,914.77	121.40	14,435,236.57	1,694,410.83	39.74856739	-80.80790155
13,300.00	89.00	150.000	11,178.81	-2,001.36	171.40	14,435,149.98	1,694,460.82	39.74832929	-80.80772435
13,400.00	89.00	150.000	11,180.56	-2,087.95	221.39	14,435,063.39	1,694,510.82	39.74809120	-80.80754715
13,500.00	89.00	150.000	11,182.31	-2,174.54	271.38	14,434,976.80	1,694,560.81	39.74785311	-80.80736995
13,600.00	89.00	150.000	11,184.06	-2,261.13	321.38	14,434,890.21	1,694,610.80	39.74761501	-80.80719276
13,700.00	89.00	150.000	11,185.82	-2,347.72	371.37	14,434,803.63	1,694,660.79	39.74737692	-80.80701556
13,800.00	89.00	150.000	11,187.57	-2,434.31	421.36	14,434,717.04	1,694,710.79	39.74713882	-80.80683837
13,900.00	89.00	150.000	11,189.32	-2,520.89	471.35	14,434,630.45	1,694,760.78	39.74690073	-80.80666117
14,000.00	89.00	150.000	11,191.08	-2,607.48	521.35	14,434,543.86	1,694,810.77	39.74666263	-80.80648398
14,100.00	89.00	150.000	11,192.83	-2,694.07	571.34	14,434,457.27	1,694,860.77	39.74642454	-80.80630679
14,200.00	89.00	150.000	11,194.58	-2,780.66	621.33	14,434,370.68	1,694,910.76	39.74618644	-80.80612960
14,300.00	89.00	150.000	11,196.33	-2,867.25	671.33	14,434,284.09	1,694,960.75	39.74594835	-80.80595241
14,400.00	89.00	150.000	11,198.09	-2,953.84	721.32	14,434,197.50	1,695,010.74	39.74571025	-80.80577522
14,500.00	89.00	150.000	11,199.84	-3,040.43	771.31	14,434,110.92	1,695,060.74	39.74547216	-80.80559804



Planning Report - Geographic

4705102257 *MOD*

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 WV Department of
 Environmental Protection

Database: DB_Aug1919_v14
Company: Tug Hill Operating LLC
Project: Marshall County, West Virginia
Site: Armstrong Pad
Well: Armstrong 1S-11 HU (slot M)
Wellbore: Original Hole
Design: rev1

Local Co-ordinate Reference: Well Armstrong 1S-11 HU (slot M)
TVD Reference: GL @ 1279.00ft
MD Reference: GL @ 1279.00ft
North Reference: Grid
Survey Calculation Method: Minimum Curvature

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
14,600.00	89.00	150.000	11,201.59	-3,127.02	821.31	14,434,024.33	1,695,110.73	39.74523406	-80.80542085
14,700.00	89.00	150.000	11,203.34	-3,213.61	871.30	14,433,937.74	1,695,160.72	39.74499596	-80.80524367
14,800.00	89.00	150.000	11,205.10	-3,300.19	921.29	14,433,851.15	1,695,210.72	39.74475787	-80.80506649
14,900.00	89.00	150.000	11,206.85	-3,386.78	971.28	14,433,764.56	1,695,260.71	39.74451977	-80.80488931
15,000.00	89.00	150.000	11,208.60	-3,473.37	1,021.28	14,433,677.97	1,695,310.70	39.74428167	-80.80471213
15,100.00	89.00	150.000	11,210.35	-3,559.96	1,071.27	14,433,591.38	1,695,360.69	39.74404357	-80.80453495
15,200.00	89.00	150.000	11,212.11	-3,646.55	1,121.26	14,433,504.80	1,695,410.69	39.74380548	-80.80435777
15,300.00	89.00	150.000	11,213.86	-3,733.14	1,171.26	14,433,418.21	1,695,460.68	39.74356738	-80.80418059
15,400.00	89.00	150.000	11,215.61	-3,819.73	1,221.25	14,433,331.62	1,695,510.67	39.74332928	-80.80400342
15,500.00	89.00	150.000	11,217.36	-3,906.32	1,271.24	14,433,245.03	1,695,560.66	39.74309118	-80.80382624
15,600.00	89.00	150.000	11,219.12	-3,992.91	1,321.23	14,433,158.44	1,695,610.66	39.74285308	-80.80364907
15,700.00	89.00	150.000	11,220.87	-4,079.49	1,371.23	14,433,071.85	1,695,660.65	39.74261498	-80.80347190
15,800.00	89.00	150.000	11,222.62	-4,166.08	1,421.22	14,432,985.26	1,695,710.64	39.74237688	-80.80329473
15,900.00	89.00	150.000	11,224.37	-4,252.67	1,471.21	14,432,898.67	1,695,760.64	39.74213878	-80.80311756
16,000.00	89.00	150.000	11,226.13	-4,339.26	1,521.21	14,432,812.09	1,695,810.63	39.74190068	-80.80294039
16,100.00	89.00	150.000	11,227.88	-4,425.85	1,571.20	14,432,725.50	1,695,860.62	39.74166258	-80.80276323
16,200.00	89.00	150.000	11,229.63	-4,512.44	1,621.19	14,432,638.91	1,695,910.61	39.74142448	-80.80258606
16,300.00	89.00	150.000	11,231.38	-4,599.03	1,671.18	14,432,552.32	1,695,960.61	39.74118638	-80.80240890
16,400.00	89.00	150.000	11,233.14	-4,685.62	1,721.18	14,432,465.73	1,696,010.60	39.74094828	-80.80223173
16,500.00	89.00	150.000	11,234.89	-4,772.21	1,771.17	14,432,379.14	1,696,060.59	39.74071018	-80.80205457
16,600.00	89.00	150.000	11,236.64	-4,858.79	1,821.16	14,432,292.55	1,696,110.59	39.74047207	-80.80187741
16,700.00	89.00	150.000	11,238.40	-4,945.38	1,871.16	14,432,205.96	1,696,160.58	39.74023397	-80.80170025
16,800.00	89.00	150.000	11,240.15	-5,031.97	1,921.15	14,432,119.38	1,696,210.57	39.73999587	-80.80152309
16,900.00	89.00	150.000	11,241.90	-5,118.56	1,971.14	14,432,032.79	1,696,260.56	39.73975777	-80.80134594
17,000.00	89.00	150.000	11,243.65	-5,205.15	2,021.14	14,431,946.20	1,696,310.56	39.73951966	-80.80116878
17,100.00	89.00	150.000	11,245.41	-5,291.74	2,071.13	14,431,859.61	1,696,360.55	39.73928156	-80.80099163
17,200.00	89.00	150.000	11,247.16	-5,378.33	2,121.12	14,431,773.02	1,696,410.54	39.73904346	-80.80081447
17,300.00	89.00	150.000	11,248.91	-5,464.92	2,171.11	14,431,686.43	1,696,460.54	39.73880535	-80.80063732
17,400.00	89.00	150.000	11,250.66	-5,551.51	2,221.11	14,431,599.84	1,696,510.53	39.73856725	-80.80046017
17,500.00	89.00	150.000	11,252.42	-5,638.09	2,271.10	14,431,513.25	1,696,560.52	39.73832914	-80.80028302
17,600.00	89.00	150.000	11,254.17	-5,724.68	2,321.09	14,431,426.67	1,696,610.51	39.73809104	-80.80010587
17,700.00	89.00	150.000	11,255.92	-5,811.27	2,371.09	14,431,340.08	1,696,660.51	39.73785293	-80.79992873
17,800.00	89.00	150.000	11,257.67	-5,897.86	2,421.08	14,431,253.49	1,696,710.50	39.73761483	-80.79975158
17,900.00	89.00	150.000	11,259.43	-5,984.45	2,471.07	14,431,166.90	1,696,760.49	39.73737672	-80.79957443
18,000.00	89.00	150.000	11,261.18	-6,071.04	2,521.06	14,431,080.31	1,696,810.49	39.73713862	-80.79939729
18,100.00	89.00	150.000	11,262.93	-6,157.63	2,571.06	14,430,993.72	1,696,860.48	39.73690051	-80.79922015
18,200.00	89.00	150.000	11,264.68	-6,244.22	2,621.05	14,430,907.13	1,696,910.47	39.73666240	-80.79904301
18,300.00	89.00	150.000	11,266.44	-6,330.81	2,671.04	14,430,820.55	1,696,960.46	39.73642430	-80.79886587
18,400.00	89.00	150.000	11,268.19	-6,417.39	2,721.04	14,430,733.96	1,697,010.46	39.73618619	-80.79868873
18,500.00	89.00	150.000	11,269.94	-6,503.98	2,771.03	14,430,647.37	1,697,060.45	39.73594808	-80.79851159
18,600.00	89.00	150.000	11,271.69	-6,590.57	2,821.02	14,430,560.78	1,697,110.44	39.73570998	-80.79833446
18,700.00	89.00	150.000	11,273.45	-6,677.16	2,871.02	14,430,474.19	1,697,160.44	39.73547187	-80.79815732
18,800.00	89.00	150.000	11,275.20	-6,763.75	2,921.01	14,430,387.60	1,697,210.43	39.73523376	-80.79798019
18,900.00	89.00	150.000	11,276.95	-6,850.34	2,971.00	14,430,301.01	1,697,260.42	39.73499565	-80.79780305
19,000.00	89.00	150.000	11,278.71	-6,936.93	3,020.99	14,430,214.42	1,697,310.41	39.73475754	-80.79762592
19,100.00	89.00	150.000	11,280.46	-7,023.52	3,070.99	14,430,127.84	1,697,360.41	39.73451943	-80.79744879
19,200.00	89.00	150.000	11,282.21	-7,110.11	3,120.98	14,430,041.25	1,697,410.40	39.73428132	-80.79727166
19,300.00	89.00	150.000	11,283.96	-7,196.69	3,170.97	14,429,954.66	1,697,460.39	39.73404322	-80.79709454
19,400.00	89.00	150.000	11,285.72	-7,283.28	3,220.97	14,429,868.07	1,697,510.39	39.73380511	-80.79691741
19,500.00	89.00	150.000	11,287.47	-7,369.87	3,270.96	14,429,781.48	1,697,560.38	39.73356700	-80.79674028
19,600.00	89.00	150.000	11,289.22	-7,456.46	3,320.95	14,429,694.89	1,697,610.37	39.73332889	-80.79656316
19,700.00	89.00	150.000	11,290.97	-7,543.05	3,370.94	14,429,608.30	1,697,660.36	39.73309077	-80.79638604
19,800.00	89.00	150.000	11,292.73	-7,629.64	3,420.94	14,429,521.71	1,697,710.36	39.73285266	-80.79620892
19,900.00	89.00	150.000	11,294.48	-7,716.23	3,470.93	14,429,435.13	1,697,760.35	39.73261455	-80.79603180
20,000.00	89.00	150.000	11,296.23	-7,802.82	3,520.92	14,429,348.54	1,697,810.34	39.73237644	-80.79585468



Planning Report - Geographic

4705102257 MOD

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-11 HU (slot M)
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-11 HU (slot M)	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
20,100.00	89.00	150.000	11,297.98	-7,889.41	3,570.92	14,429,261.95	1,697,860.34	39.73213833	-80.79567756
20,200.00	89.00	150.000	11,299.74	-7,975.99	3,620.91	14,429,175.36	1,697,910.33	39.73190022	-80.79550044
20,300.00	89.00	150.000	11,301.49	-8,062.58	3,670.90	14,429,088.77	1,697,960.32	39.73166211	-80.79532333
20,400.00	89.00	150.000	11,303.24	-8,149.17	3,720.90	14,429,002.18	1,698,010.31	39.73142399	-80.79514621
20,500.00	89.00	150.000	11,304.99	-8,235.76	3,770.89	14,428,915.59	1,698,060.31	39.73118588	-80.79496910
20,600.00	89.00	150.000	11,306.75	-8,322.35	3,820.88	14,428,829.00	1,698,110.30	39.73094777	-80.79479199
20,700.00	89.00	150.000	11,308.50	-8,408.94	3,870.87	14,428,742.42	1,698,160.29	39.73070965	-80.79461488
20,800.00	89.00	150.000	11,310.25	-8,495.53	3,920.87	14,428,655.83	1,698,210.29	39.73047154	-80.79443777
20,900.00	89.00	150.000	11,312.00	-8,582.12	3,970.86	14,428,569.24	1,698,260.28	39.73023343	-80.79426066
21,000.00	89.00	150.000	11,313.76	-8,668.71	4,020.85	14,428,482.65	1,698,310.27	39.72999531	-80.79408355
21,100.00	89.00	150.000	11,315.51	-8,755.29	4,070.85	14,428,396.06	1,698,360.26	39.72975720	-80.79390645
21,200.00	89.00	150.000	11,317.26	-8,841.88	4,120.84	14,428,309.47	1,698,410.26	39.72951908	-80.79372934
21,300.00	89.00	150.000	11,319.01	-8,928.47	4,170.83	14,428,222.88	1,698,460.25	39.72928097	-80.79355224
21,400.00	89.00	150.000	11,320.77	-9,015.06	4,220.82	14,428,136.30	1,698,510.24	39.72904285	-80.79337514
21,500.00	89.00	150.000	11,322.52	-9,101.65	4,270.82	14,428,049.71	1,698,560.24	39.72880474	-80.79319804
21,600.00	89.00	150.000	11,324.27	-9,188.24	4,320.81	14,427,963.12	1,698,610.23	39.72856662	-80.79302094
21,700.00	89.00	150.000	11,326.03	-9,274.83	4,370.80	14,427,876.53	1,698,660.22	39.72832851	-80.79284384
21,800.00	89.00	150.000	11,327.78	-9,361.42	4,420.80	14,427,789.94	1,698,710.21	39.72809039	-80.79266674
21,900.00	89.00	150.000	11,329.53	-9,448.01	4,470.79	14,427,703.35	1,698,760.21	39.72785227	-80.79248964
22,000.00	89.00	150.000	11,331.28	-9,534.59	4,520.78	14,427,616.76	1,698,810.20	39.72761416	-80.79231255
22,100.00	89.00	150.000	11,333.04	-9,621.18	4,570.78	14,427,530.17	1,698,860.19	39.72737604	-80.79213546
22,155.03	89.00	150.000	11,334.00	-9,668.83	4,598.29	14,427,482.52	1,698,887.70	39.72724500	-80.79203800

PBHL/TD 22155.03 MD/11334.00 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-11HU LP - hit/miss target - Shape - Point	0.00	0.000	11,151.00	-627.67	-621.66	14,436,523.67	1,693,667.77	39.75210650	-80.81053549
- plan misses target center by 0.05ft at 11713.57ft MD (11151.00 TVD, -627.69 N, -621.70 E)									
Armstrong 1S-11HU BHI - plan hits target center - Point	0.00	0.000	11,334.00	-9,668.83	4,598.29	14,427,482.52	1,698,887.70	39.72724500	-80.79203800

Plan Annotations					Comment	RECEIVED Office of Oil and Gas DEC 04 2019 WV Department of Environmental Protection
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates				
		+N/-S (ft)	+E/-W (ft)			
400.00	400.00	0.00	0.00	KOP Begin 1°/100' build		
600.00	599.96	0.00	3.49	Begin 2.00° tangent		
4,002.11	4,000.00	0.00	122.22	Begin 1°/100' drop		
4,202.11	4,199.96	0.00	125.71	Begin vertical hold		
6,002.15	6,000.00	0.00	125.71	Begin 2°/100' build		
6,724.89	6,715.10	13.53	36.04	Begin 14.45° tangent		
10,247.05	10,125.76	144.67	-833.31	Begin 6°/100' build/turn		
11,214.28	10,979.17	-215.61	-821.75	Begin 8°/100' build/turn		
11,713.49	11,151.00	-627.62	-621.75	Begin 89.00° lateral		
22,155.03	11,334.00	-9,668.83	4,598.29	PBHL/TD 22155.03 MD/11334.00 TVD		