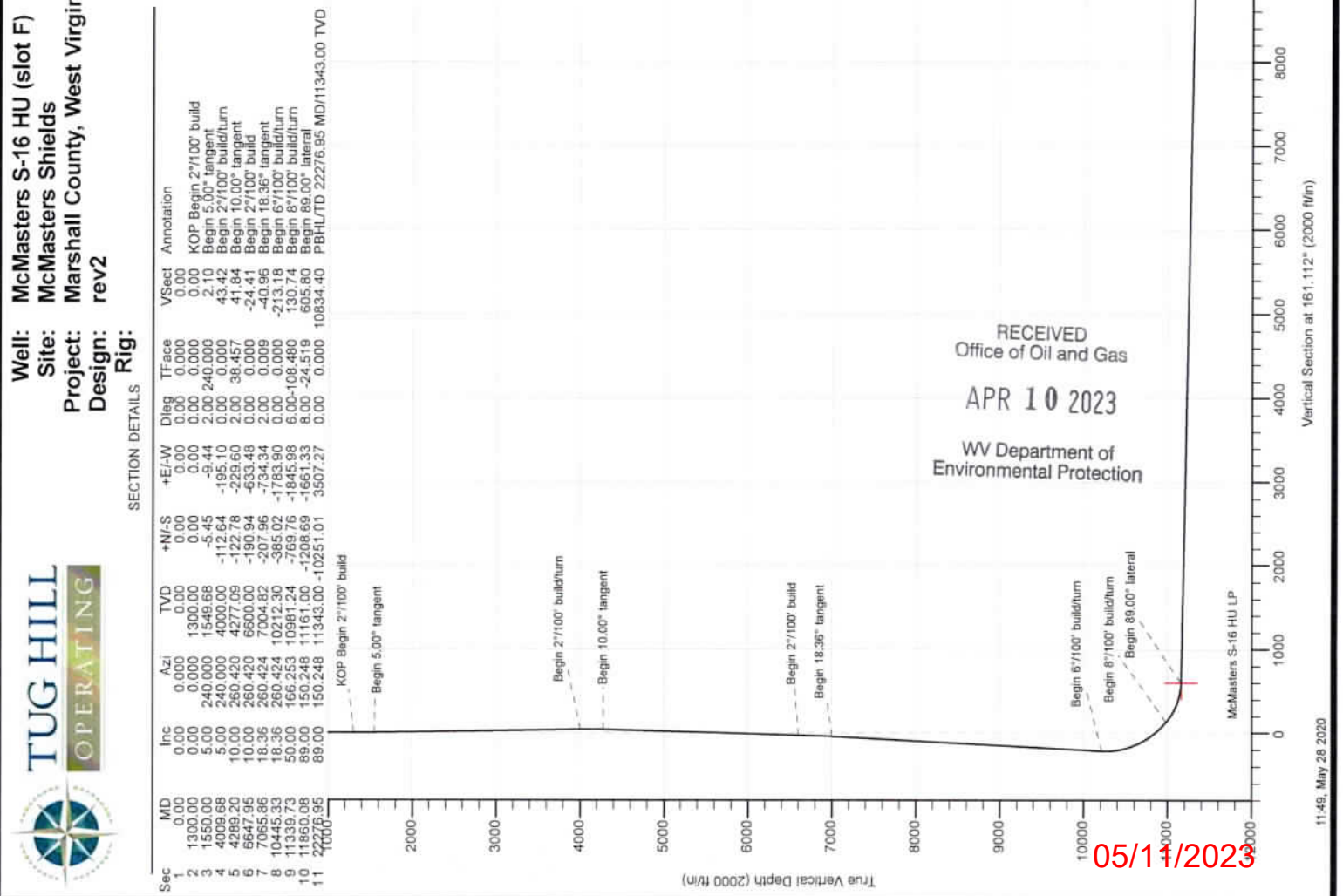
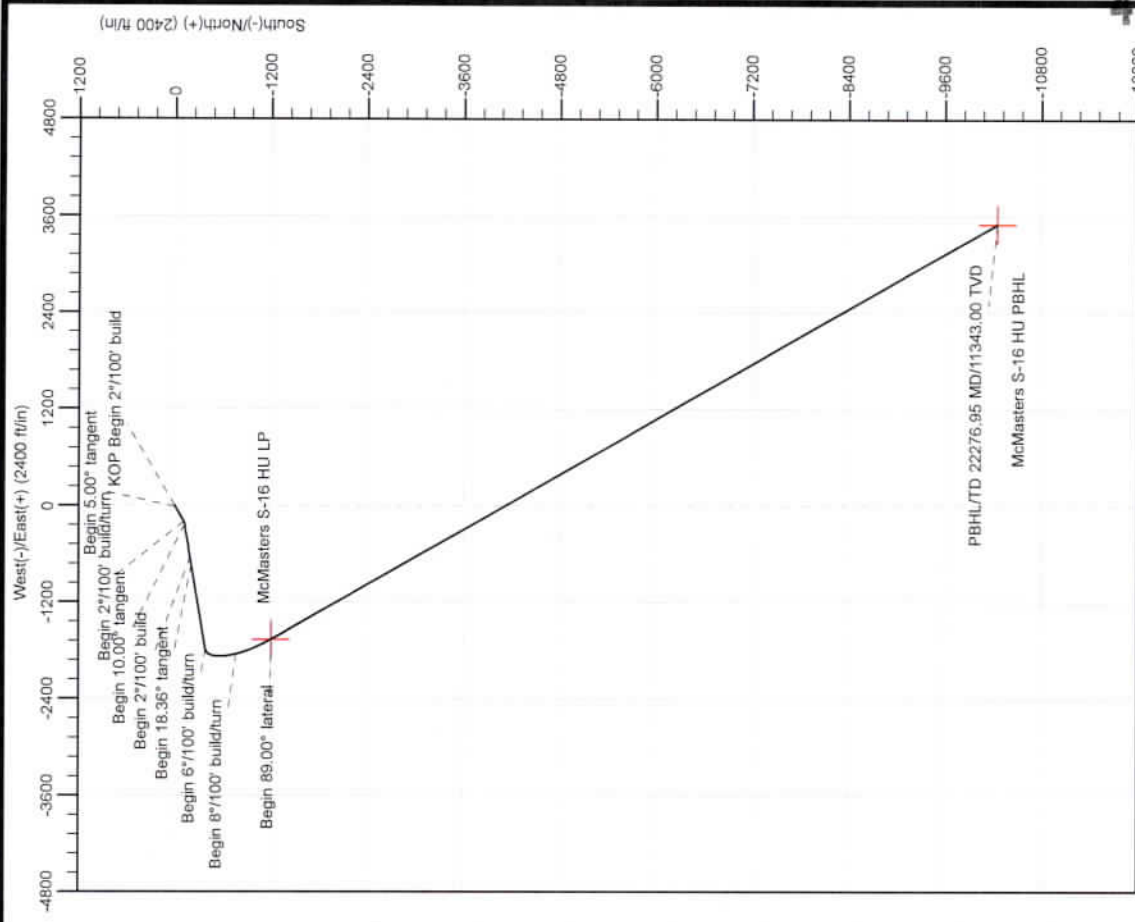




Well: **McMasters S-16 HU (slot F)**
 Site: **McMasters Shields**
 Project: **Marshall County, West Virginia**
 Design: **rev2**
 Rig:

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	Vsect	Annotation
1	1300.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 27'100" build
2	1550.00	5.00	240.000	1300.00	0.00	0.00	0.00	0.00	0.00	Begin 5.00° tangent
3	4009.68	5.00	240.000	1548.68	-5.45	-9.44	2.00	240.000	2.10	Begin 27'100" build/turn
4	4289.20	10.00	260.420	4000.00	-112.64	-195.10	0.00	0.000	43.42	Begin 10.00° tangent
5	6647.95	10.00	260.420	4277.09	-122.78	-229.60	2.00	38.457	41.84	Begin 27'100" build
6	7065.86	18.36	260.424	6600.00	-190.94	-633.48	0.00	0.000	-24.41	Begin 18.36° tangent
7	10445.33	18.36	260.424	7004.82	-207.96	-734.34	2.00	0.000	-40.96	Begin 67'100" build/turn
8	11339.73	50.00	166.253	10212.30	-385.02	-1783.90	0.00	0.000	-213.18	Begin 87'100" build/turn
9	11850.08	89.00	150.248	10981.24	-769.76	-1845.98	6.00	-108.480	130.74	Begin 89.00° lateral
10	22276.95	89.00	150.248	11343.00	-10251.01	-1661.33	8.00	-24.519	605.80	PBHL/TD 22276.95 MD/11343.00 TVD
11	22276.95	89.00	150.248	11343.00	-10251.01	3507.27	0.00	0.000	10834.40	



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Geoidic 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 @ 1206.00ft

Northing: 14438522.61
 Easting: 1700118.91
 Latitude: 39.76030273
 Longitude: -80.78755753

To convert a Magnetic Direction to a Grid Direction, Subtract 8.84°

Azimuths to Grid North
 True North: -0.14°
 Magnetic North: -8.84°

Magnetic Field
 Strength: 51883.6snT
 Dip Angle: 66.74°
 Date: 12/9/2019
 Model: IGRF2015

Total Corr (M->G):



05/11/2023

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

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	McMasters Shields				
Site Position:		Northing:	14,439,441.76 usft	Latitude:	39.76008050
From:	Lat/Long	Easting:	1,700,145.18 usft	Longitude:	-80.78746471
Position Uncertainty:	0.00 ft	Slot Radius:	13-3/16 "	Grid Convergence:	0.136 "

Well	McMasters S-16 HU (slot F)					
Well Position	+N/-S	0.00 ft	Northing:	14,439,522.62 usft	Latitude:	39.76030273
	+E/-W	0.00 ft	Easting:	1,700,118.91 usft	Longitude:	-80.78755753
Position Uncertainty		0.00 ft	Wellhead Elevation:		Ground Level:	1,206.00 ft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	12/9/2019	-8.706	66.739	51,883.56494778

Design	rev2			
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	161.112

Plan Survey Tool Program	Date	5/28/2020		
Depth From (ft)	Depth To (ft)	Survey (Wellbore)	Tool Name	Remarks
1	0.00	22,276.95 rev2 (Original Hole)	MWD MWD - Standard	

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Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

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	
1,300.00	0.00	0.000	1,300.00	0.00	0.00	0.00	0.00	0.00	0.000	
1,550.00	5.00	240.000	1,549.68	-5.45	-9.44	2.00	2.00	0.00	240.000	
4,009.68	5.00	240.000	4,000.00	-112.64	-195.10	0.00	0.00	0.00	0.000	
4,289.20	10.00	260.420	4,277.09	-122.78	-229.60	2.00	1.79	7.31	38.457	
6,647.95	10.00	260.420	6,600.00	-190.94	-633.48	0.00	0.00	0.00	0.000	
7,065.86	18.36	260.424	7,004.82	-207.96	-734.34	2.00	2.00	0.00	0.009	
10,445.33	18.36	260.424	10,212.30	-385.02	-1,783.90	0.00	0.00	0.00	0.000	
11,339.73	50.00	166.253	10,981.24	-769.76	-1,845.98	6.00	3.54	-10.53	-108.480	
11,860.08	89.00	150.248	11,161.00	-1,208.69	-1,661.33	8.00	7.49	-3.08	-24.519	
22,276.95	89.00	150.248	11,343.00	-10,251.01	3,507.27	0.00	0.00	0.00	0.000	McMasters S-16 HU F

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Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

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	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
100.00	0.00	0.000	100.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
200.00	0.00	0.000	200.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
300.00	0.00	0.000	300.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
400.00	0.00	0.000	400.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
500.00	0.00	0.000	500.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
600.00	0.00	0.000	600.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
700.00	0.00	0.000	700.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
800.00	0.00	0.000	800.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
900.00	0.00	0.000	900.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
1,000.00	0.00	0.000	1,000.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
1,100.00	0.00	0.000	1,100.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
1,200.00	0.00	0.000	1,200.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
1,300.00	0.00	0.000	1,300.00	0.00	0.00	14,439,522.62	1,700,118.91	39.76030273	-80.78755753	
KOP Begin 2°/100' build										
1,400.00	2.00	240.000	1,399.98	-0.87	-1.51	14,439,521.74	1,700,117.40	39.76030035	-80.78756292	
1,500.00	4.00	240.000	1,499.84	-3.49	-6.04	14,439,519.13	1,700,112.86	39.76029319	-80.78757907	
1,550.00	5.00	240.000	1,549.68	-5.45	-9.44	14,439,517.16	1,700,109.47	39.76028782	-80.78759117	
Begin 5.00° tangent										
1,600.00	5.00	240.000	1,599.49	-7.63	-13.21	14,439,514.99	1,700,105.69	39.76028186	-80.78760462	
1,700.00	5.00	240.000	1,699.11	-11.99	-20.76	14,439,510.63	1,700,098.14	39.76026995	-80.78763151	
1,800.00	5.00	240.000	1,798.73	-16.35	-28.31	14,439,506.27	1,700,090.60	39.76025803	-80.78765841	
1,900.00	5.00	240.000	1,898.35	-20.70	-35.86	14,439,501.91	1,700,083.05	39.76024611	-80.78768530	
2,000.00	5.00	240.000	1,997.97	-25.06	-43.41	14,439,497.55	1,700,075.50	39.76023419	-80.78771220	
2,100.00	5.00	240.000	2,097.59	-29.42	-50.95	14,439,493.20	1,700,067.95	39.76022227	-80.78773909	
2,200.00	5.00	240.000	2,197.21	-33.78	-58.50	14,439,488.84	1,700,060.41	39.76021035	-80.78776599	
2,300.00	5.00	240.000	2,296.83	-38.13	-66.05	14,439,484.48	1,700,052.86	39.76019843	-80.78779288	
2,400.00	5.00	240.000	2,396.45	-42.49	-73.60	14,439,480.12	1,700,045.31	39.76018652	-80.78781978	
2,500.00	5.00	240.000	2,496.07	-46.85	-81.15	14,439,475.77	1,700,037.76	39.76017460	-80.78784667	
2,600.00	5.00	240.000	2,595.69	-51.21	-88.69	14,439,471.41	1,700,030.21	39.76016268	-80.78787357	
2,700.00	5.00	240.000	2,695.31	-55.57	-96.24	14,439,467.05	1,700,022.67	39.76015076	-80.78790046	
2,800.00	5.00	240.000	2,794.93	-59.92	-103.79	14,439,462.69	1,700,015.12	39.76013884	-80.78792735	
2,900.00	5.00	240.000	2,894.55	-64.28	-111.34	14,439,458.33	1,700,007.57	39.76012692	-80.78795425	
3,000.00	5.00	240.000	2,994.17	-68.64	-118.89	14,439,453.98	1,700,000.02	39.76011500	-80.78798114	
3,100.00	5.00	240.000	3,093.78	-73.00	-126.43	14,439,449.62	1,699,992.47	39.76010309	-80.78800804	
3,200.00	5.00	240.000	3,193.40	-77.35	-133.98	14,439,445.26	1,699,984.93	39.76009117	-80.78803493	
3,300.00	5.00	240.000	3,293.02	-81.71	-141.53	14,439,440.90	1,699,977.38	39.76007925	-80.78806183	
3,400.00	5.00	240.000	3,392.64	-86.07	-149.08	14,439,436.55	1,699,969.83	39.76006733	-80.78808872	
3,500.00	5.00	240.000	3,492.26	-90.43	-156.63	14,439,432.19	1,699,962.28	39.76005541	-80.78811562	
3,600.00	5.00	240.000	3,591.88	-94.79	-164.17	14,439,427.83	1,699,954.73	39.76004349	-80.78814251	
3,700.00	5.00	240.000	3,691.50	-99.14	-171.72	14,439,423.47	1,699,947.19	39.76003157	-80.78816941	
3,800.00	5.00	240.000	3,791.12	-103.50	-179.27	14,439,419.11	1,699,939.64	39.76001965	-80.78819630	
3,900.00	5.00	240.000	3,890.74	-107.86	-186.82	14,439,414.76	1,699,932.09	39.76000774	-80.78822320	
4,000.00	5.00	240.000	3,990.36	-112.22	-194.36	14,439,410.40	1,699,924.54	39.75999582	-80.78825009	
4,009.68	5.00	240.000	4,000.00	-112.64	-195.10	14,439,409.98	1,699,923.81	39.75999466	-80.78825269	
Begin 2°/100' build/turn										
4,100.00	6.51	249.955	4,089.87	-116.36	-203.32	14,439,406.25	1,699,915.59	39.75998449	-80.78828198	
4,200.00	8.32	256.571	4,189.03	-119.99	-215.68	14,439,402.63	1,699,903.22	39.75997462	-80.78832602	
4,289.20	10.00	260.420	4,277.09	-122.78	-229.60	14,439,399.84	1,699,889.31	39.75996705	-80.78837557	
Begin 10.00° tangent										
4,300.00	10.00	260.420	4,287.72	-123.09	-231.45	14,439,399.53	1,699,887.46	39.75996620	-80.78838215	
4,400.00	10.00	260.420	4,386.20	-125.98	-248.57	14,439,396.64	1,699,870.33	39.75995838	-80.78844310	
4,500.00	10.00	260.420	4,484.69	-128.87	-265.70	14,439,393.75	1,699,853.21	39.75995055	-80.78850405	
4,600.00	10.00	260.420	4,583.17	-131.76	-282.82	14,439,390.86	1,699,836.09	39.75994273	-80.78856500	

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
4,700.00	10.00	260.420	4,681.65	-134.65	-299.94	14,439,387.97	1,699,818.97	39.75993490	-80.78862596	
4,800.00	10.00	260.420	4,780.13	-137.54	-317.06	14,439,385.08	1,699,801.84	39.75992707	-80.78868691	
4,900.00	10.00	260.420	4,878.61	-140.43	-334.19	14,439,382.19	1,699,784.72	39.75991925	-80.78874786	
5,000.00	10.00	260.420	4,977.09	-143.32	-351.31	14,439,379.30	1,699,767.60	39.75991142	-80.78880881	
5,100.00	10.00	260.420	5,075.57	-146.21	-368.43	14,439,376.41	1,699,750.48	39.75990360	-80.78886977	
5,200.00	10.00	260.420	5,174.05	-149.10	-385.56	14,439,373.52	1,699,733.35	39.75989577	-80.78893072	
5,300.00	10.00	260.420	5,272.53	-151.99	-402.68	14,439,370.63	1,699,716.23	39.75988795	-80.78899167	
5,400.00	10.00	260.420	5,371.01	-154.88	-419.80	14,439,367.74	1,699,699.11	39.75988012	-80.78905262	
5,500.00	10.00	260.420	5,469.49	-157.77	-436.92	14,439,364.85	1,699,681.98	39.75987229	-80.78911357	
5,600.00	10.00	260.420	5,567.97	-160.66	-454.05	14,439,361.96	1,699,664.86	39.75986447	-80.78917453	
5,700.00	10.00	260.420	5,666.45	-163.55	-471.17	14,439,359.07	1,699,647.74	39.75985664	-80.78923548	
5,800.00	10.00	260.420	5,764.94	-166.44	-488.29	14,439,356.18	1,699,630.62	39.75984882	-80.78929643	
5,900.00	10.00	260.420	5,863.42	-169.33	-505.41	14,439,353.29	1,699,613.49	39.75984099	-80.78935738	
6,000.00	10.00	260.420	5,961.90	-172.22	-522.54	14,439,350.40	1,699,596.37	39.75983316	-80.78941833	
6,100.00	10.00	260.420	6,060.38	-175.11	-539.66	14,439,347.51	1,699,579.25	39.75982534	-80.78947929	
6,200.00	10.00	260.420	6,158.86	-178.00	-556.78	14,439,344.62	1,699,562.13	39.75981751	-80.78954024	
6,300.00	10.00	260.420	6,257.34	-180.89	-573.90	14,439,341.73	1,699,545.00	39.75980969	-80.78960119	
6,400.00	10.00	260.420	6,355.82	-183.78	-591.03	14,439,338.84	1,699,527.88	39.75980186	-80.78966214	
6,500.00	10.00	260.420	6,454.30	-186.67	-608.15	14,439,335.95	1,699,510.76	39.75979403	-80.78972309	
6,600.00	10.00	260.420	6,552.78	-189.56	-625.27	14,439,333.06	1,699,493.64	39.75978621	-80.78978404	
6,647.95	10.00	260.420	6,600.00	-190.94	-633.48	14,439,331.67	1,699,485.43	39.75978245	-80.78981327	
Begin 2°/100' build										
6,700.00	11.04	260.421	6,651.18	-192.52	-642.85	14,439,330.09	1,699,476.05	39.75977817	-80.78984663	
6,800.00	13.04	260.422	6,748.97	-195.99	-663.42	14,439,326.62	1,699,455.49	39.75976877	-80.78991985	
6,900.00	15.04	260.423	6,845.98	-200.03	-687.35	14,439,322.58	1,699,431.56	39.75975784	-80.79000501	
7,000.00	17.04	260.424	6,942.08	-204.63	-714.59	14,439,317.99	1,699,404.32	39.75974539	-80.79010200	
7,065.86	18.36	260.424	7,004.82	-207.96	-734.34	14,439,314.66	1,699,384.57	39.75973637	-80.79017228	
Begin 18.36° tangent										
7,100.00	18.36	260.424	7,037.22	-209.75	-744.94	14,439,312.87	1,699,373.97	39.75973153	-80.79021002	
7,200.00	18.36	260.424	7,132.14	-214.99	-776.00	14,439,307.63	1,699,342.91	39.75971734	-80.79032057	
7,300.00	18.36	260.424	7,227.05	-220.23	-807.05	14,439,302.39	1,699,311.86	39.75970315	-80.79043113	
7,400.00	18.36	260.424	7,321.96	-225.47	-838.11	14,439,297.15	1,699,280.80	39.75968896	-80.79054168	
7,500.00	18.36	260.424	7,416.87	-230.71	-869.17	14,439,291.91	1,699,249.74	39.75967477	-80.79065224	
7,600.00	18.36	260.424	7,511.78	-235.94	-900.22	14,439,286.67	1,699,218.69	39.75966058	-80.79076279	
7,700.00	18.36	260.424	7,606.69	-241.18	-931.28	14,439,281.43	1,699,187.63	39.75964639	-80.79087334	
7,800.00	18.36	260.424	7,701.60	-246.42	-962.34	14,439,276.19	1,699,156.57	39.75963220	-80.79098390	
7,900.00	18.36	260.424	7,796.51	-251.66	-993.39	14,439,270.95	1,699,125.52	39.75961801	-80.79109445	
8,000.00	18.36	260.424	7,891.42	-256.90	-1,024.45	14,439,265.71	1,699,094.46	39.75960382	-80.79120500	
8,100.00	18.36	260.424	7,986.33	-262.14	-1,055.51	14,439,260.47	1,699,063.40	39.75958963	-80.79131556	
8,200.00	18.36	260.424	8,081.24	-267.38	-1,086.56	14,439,255.23	1,699,032.35	39.75957544	-80.79142611	
8,300.00	18.36	260.424	8,176.15	-272.62	-1,117.62	14,439,249.99	1,699,001.29	39.75956125	-80.79153666	
8,400.00	18.36	260.424	8,271.06	-277.86	-1,148.68	14,439,244.76	1,698,970.23	39.75954706	-80.79164722	
8,500.00	18.36	260.424	8,365.97	-283.10	-1,179.74	14,439,239.52	1,698,939.17	39.75953287	-80.79175777	
8,600.00	18.36	260.424	8,460.88	-288.34	-1,210.79	14,439,234.28	1,698,908.12	39.75951868	-80.79186832	
8,700.00	18.36	260.424	8,555.79	-293.58	-1,241.85	14,439,229.04	1,698,877.06	39.75950448	-80.79197887	
8,800.00	18.36	260.424	8,650.70	-298.82	-1,272.91	14,439,223.80	1,698,846.00	39.75949029	-80.79208943	
8,900.00	18.36	260.424	8,745.61	-304.06	-1,303.96	14,439,218.56	1,698,814.95	39.75947610	-80.79219998	
9,000.00	18.36	260.424	8,840.53	-309.30	-1,335.02	14,439,213.32	1,698,783.89	39.75946191	-80.79231053	
9,100.00	18.36	260.424	8,935.44	-314.54	-1,366.08	14,439,208.08	1,698,752.83	39.75944772	-80.79242109	
9,200.00	18.36	260.424	9,030.35	-319.78	-1,397.13	14,439,202.84	1,698,721.78	39.75943353	-80.79253164	
9,300.00	18.36	260.424	9,125.26	-325.02	-1,428.19	14,439,197.60	1,698,690.72	39.75941934	-80.79264219	
9,400.00	18.36	260.424	9,220.17	-330.25	-1,459.25	14,439,192.36	1,698,659.66	39.75940515	-80.79275274	
9,500.00	18.36	260.424	9,315.08	-335.49	-1,490.30	14,439,187.12	1,698,628.61	39.75939095	-80.79286330	
9,600.00	18.36	260.424	9,409.99	-340.73	-1,521.36	14,439,181.88	1,698,597.55	39.75937676	-80.79297385	

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
9,700.00	18.36	260.424	9,504.90	-345.97	-1,552.42	14,439,176.64	1,698,566.49	39.75936257	-80.79308440	
9,800.00	18.36	260.424	9,599.81	-351.21	-1,583.48	14,439,171.40	1,698,535.44	39.75934838	-80.79319495	
9,900.00	18.36	260.424	9,694.72	-356.45	-1,614.53	14,439,166.16	1,698,504.38	39.75933419	-80.79330551	
10,000.00	18.36	260.424	9,789.63	-361.69	-1,645.59	14,439,160.92	1,698,473.32	39.75931999	-80.79341606	
10,100.00	18.36	260.424	9,884.54	-366.93	-1,676.65	14,439,155.69	1,698,442.27	39.75930580	-80.79352661	
10,200.00	18.36	260.424	9,979.45	-372.17	-1,707.70	14,439,150.45	1,698,411.21	39.75929161	-80.79363716	
10,300.00	18.36	260.424	10,074.36	-377.41	-1,738.76	14,439,145.21	1,698,380.15	39.75927742	-80.79374772	
10,400.00	18.36	260.424	10,169.27	-382.65	-1,769.82	14,439,139.97	1,698,349.09	39.75926322	-80.79385827	
10,445.33	18.36	260.424	10,212.30	-385.02	-1,783.90	14,439,137.59	1,698,335.02	39.75925679	-80.79390838	
Begin 6°/100' build/turn										
10,500.00	17.59	250.077	10,264.31	-389.27	-1,800.15	14,439,133.34	1,698,318.76	39.75924523	-80.79396627	
10,600.00	17.68	230.180	10,359.70	-404.16	-1,826.04	14,439,118.46	1,698,292.87	39.75920452	-80.79405851	
10,700.00	19.63	212.359	10,454.52	-428.09	-1,846.71	14,439,094.52	1,698,272.20	39.75913891	-80.79413226	
10,800.00	22.98	198.590	10,547.73	-460.82	-1,861.94	14,439,061.80	1,698,256.97	39.75904914	-80.79418672	
10,900.00	27.21	188.519	10,638.31	-501.97	-1,871.56	14,439,020.65	1,698,247.35	39.75893617	-80.79422128	
11,000.00	31.98	181.112	10,725.27	-551.11	-1,875.47	14,438,971.51	1,698,243.44	39.75880126	-80.79423558	
11,100.00	37.07	175.500	10,807.65	-607.68	-1,873.61	14,438,914.93	1,698,245.30	39.75864587	-80.79422945	
11,200.00	42.37	171.092	10,884.55	-671.08	-1,866.02	14,438,851.54	1,698,252.89	39.75847171	-80.79420296	
11,300.00	47.81	167.507	10,955.13	-740.61	-1,852.78	14,438,782.01	1,698,266.13	39.75828070	-80.79415641	
11,339.73	50.00	166.253	10,981.24	-769.76	-1,845.98	14,438,752.86	1,698,272.93	39.75820059	-80.79413245	
Begin 8°/100' build/turn										
11,400.00	54.41	163.795	11,018.17	-815.75	-1,833.65	14,438,706.87	1,698,285.26	39.75807422	-80.79408894	
11,500.00	61.83	160.256	11,070.96	-896.41	-1,807.37	14,438,626.21	1,698,311.55	39.75785253	-80.79399608	
11,600.00	69.33	157.181	11,112.28	-981.15	-1,774.28	14,438,541.46	1,698,344.63	39.75761959	-80.79387905	
11,700.00	76.87	154.398	11,141.34	-1,068.33	-1,735.03	14,438,454.29	1,698,383.88	39.75737994	-80.79374012	
11,800.00	84.44	151.782	11,157.57	-1,156.23	-1,690.39	14,438,366.39	1,698,428.52	39.75713825	-80.79358198	
11,860.08	89.00	150.248	11,161.00	-1,208.69	-1,661.33	14,438,313.93	1,698,457.58	39.75699400	-80.79347901	
Begin 89.00° lateral										
11,900.00	89.00	150.248	11,161.70	-1,243.34	-1,641.52	14,438,279.28	1,698,477.39	39.75689872	-80.79340882	
12,000.00	89.00	150.248	11,163.45	-1,330.14	-1,591.90	14,438,192.48	1,698,527.01	39.75666002	-80.79323299	
12,100.00	89.00	150.248	11,165.20	-1,416.94	-1,542.29	14,438,105.67	1,698,576.62	39.75642131	-80.79305716	
12,200.00	89.00	150.248	11,166.94	-1,503.75	-1,492.67	14,438,018.87	1,698,626.24	39.75618261	-80.79288132	
12,300.00	89.00	150.248	11,168.69	-1,590.55	-1,443.05	14,437,932.06	1,698,675.86	39.75594390	-80.79270549	
12,400.00	89.00	150.248	11,170.44	-1,677.36	-1,393.43	14,437,845.26	1,698,725.48	39.75570520	-80.79252966	
12,500.00	89.00	150.248	11,172.18	-1,764.16	-1,343.82	14,437,758.46	1,698,775.09	39.75546649	-80.79235383	
12,600.00	89.00	150.248	11,173.93	-1,850.97	-1,294.20	14,437,671.65	1,698,824.71	39.75522778	-80.79217801	
12,700.00	89.00	150.248	11,175.68	-1,937.77	-1,244.58	14,437,584.85	1,698,874.33	39.75498908	-80.79200218	
12,800.00	89.00	150.248	11,177.43	-2,024.58	-1,194.96	14,437,498.04	1,698,923.95	39.75475037	-80.79182636	
12,900.00	89.00	150.248	11,179.17	-2,111.38	-1,145.35	14,437,411.24	1,698,973.56	39.75451166	-80.79165053	
13,000.00	89.00	150.248	11,180.92	-2,198.19	-1,095.73	14,437,324.43	1,699,023.18	39.75427296	-80.79147471	
13,100.00	89.00	150.248	11,182.67	-2,284.99	-1,046.11	14,437,237.63	1,699,072.80	39.75403425	-80.79129889	
13,200.00	89.00	150.248	11,184.41	-2,371.80	-996.49	14,437,150.82	1,699,122.42	39.75379554	-80.79112307	
13,300.00	89.00	150.248	11,186.16	-2,458.60	-946.88	14,437,064.02	1,699,172.03	39.75355683	-80.79094725	
13,400.00	89.00	150.248	11,187.91	-2,545.40	-897.26	14,436,977.22	1,699,221.65	39.75331812	-80.79077143	
13,500.00	89.00	150.248	11,189.66	-2,632.21	-847.64	14,436,890.41	1,699,271.27	39.75307942	-80.79059561	
13,600.00	89.00	150.248	11,191.40	-2,719.01	-798.02	14,436,803.61	1,699,320.89	39.75284071	-80.79041980	
13,700.00	89.00	150.248	11,193.15	-2,805.82	-748.41	14,436,716.80	1,699,370.50	39.75260200	-80.79024399	
13,800.00	89.00	150.248	11,194.90	-2,892.62	-698.79	14,436,630.00	1,699,420.12	39.75236329	-80.79006817	
13,900.00	89.00	150.248	11,196.64	-2,979.43	-649.17	14,436,543.19	1,699,469.74	39.75212458	-80.78989236	
14,000.00	89.00	150.248	11,198.39	-3,066.23	-599.55	14,436,456.39	1,699,519.36	39.75188587	-80.78971655	
14,100.00	89.00	150.248	11,200.14	-3,153.04	-549.94	14,436,369.58	1,699,568.97	39.75164716	-80.78954074	
14,200.00	89.00	150.248	11,201.89	-3,239.84	-500.32	14,436,282.78	1,699,618.59	39.75140845	-80.78936493	
14,300.00	89.00	150.248	11,203.63	-3,326.65	-450.70	14,436,195.98	1,699,668.21	39.75116974	-80.78918913	
14,400.00	89.00	150.248	11,205.38	-3,413.45	-401.08	14,436,109.17	1,699,717.83	39.75093102	-80.78901332	

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
14,500.00	89.00	150.248	11,207.13	-3,500.26	-351.46	14,436,022.37	1,699,767.44	39.75069231	-80.78883752	
14,600.00	89.00	150.248	11,208.87	-3,587.06	-301.85	14,435,935.56	1,699,817.06	39.75045360	-80.78866171	
14,700.00	89.00	150.248	11,210.62	-3,673.86	-252.23	14,435,848.76	1,699,866.68	39.75021489	-80.78848591	
14,800.00	89.00	150.248	11,212.37	-3,760.67	-202.61	14,435,761.95	1,699,916.30	39.74997618	-80.78831011	
14,900.00	89.00	150.248	11,214.11	-3,847.47	-152.99	14,435,675.15	1,699,965.91	39.74973746	-80.78813431	
15,000.00	89.00	150.248	11,215.86	-3,934.28	-103.38	14,435,588.34	1,700,015.53	39.74949875	-80.78795851	
15,100.00	89.00	150.248	11,217.61	-4,021.08	-53.76	14,435,501.54	1,700,065.15	39.74926004	-80.78778272	
15,200.00	89.00	150.248	11,219.36	-4,107.89	-4.14	14,435,414.74	1,700,114.77	39.74902133	-80.78760692	
15,300.00	89.00	150.248	11,221.10	-4,194.69	45.48	14,435,327.93	1,700,164.38	39.74878261	-80.78743112	
15,400.00	89.00	150.248	11,222.85	-4,281.50	95.09	14,435,241.13	1,700,214.00	39.74854390	-80.78725533	
15,500.00	89.00	150.248	11,224.60	-4,368.30	144.71	14,435,154.32	1,700,263.62	39.74830518	-80.78707954	
15,600.00	89.00	150.248	11,226.34	-4,455.11	194.33	14,435,067.52	1,700,313.24	39.74806647	-80.78690375	
15,700.00	89.00	150.248	11,228.09	-4,541.91	243.95	14,434,980.71	1,700,362.85	39.74782775	-80.78672796	
15,800.00	89.00	150.248	11,229.84	-4,628.72	293.56	14,434,893.91	1,700,412.47	39.74758904	-80.78655217	
15,900.00	89.00	150.248	11,231.59	-4,715.52	343.18	14,434,807.10	1,700,462.09	39.74735032	-80.78637638	
16,000.00	89.00	150.248	11,233.33	-4,802.32	392.80	14,434,720.30	1,700,511.71	39.74711161	-80.78620060	
16,100.00	89.00	150.248	11,235.08	-4,889.13	442.42	14,434,633.50	1,700,561.32	39.74687289	-80.78602481	
16,200.00	89.00	150.248	11,236.83	-4,975.93	492.03	14,434,546.69	1,700,610.94	39.74663418	-80.78584903	
16,300.00	89.00	150.248	11,238.57	-5,062.74	541.65	14,434,459.89	1,700,660.56	39.74639546	-80.78567324	
16,400.00	89.00	150.248	11,240.32	-5,149.54	591.27	14,434,373.08	1,700,710.18	39.74615674	-80.78549746	
16,500.00	89.00	150.248	11,242.07	-5,236.35	640.89	14,434,286.28	1,700,759.79	39.74591803	-80.78532168	
16,600.00	89.00	150.248	11,243.82	-5,323.15	690.50	14,434,199.47	1,700,809.41	39.74567931	-80.78514590	
16,700.00	89.00	150.248	11,245.56	-5,409.96	740.12	14,434,112.67	1,700,859.03	39.74544059	-80.78497013	
16,800.00	89.00	150.248	11,247.31	-5,496.76	789.74	14,434,025.86	1,700,908.65	39.74520187	-80.78479435	
16,900.00	89.00	150.248	11,249.06	-5,583.57	839.36	14,433,939.06	1,700,958.26	39.74496316	-80.78461857	
17,000.00	89.00	150.248	11,250.80	-5,670.37	888.98	14,433,852.26	1,701,007.88	39.74472444	-80.78444280	
17,100.00	89.00	150.248	11,252.55	-5,757.18	938.59	14,433,765.45	1,701,057.50	39.74448572	-80.78426703	
17,200.00	89.00	150.248	11,254.30	-5,843.98	988.21	14,433,678.65	1,701,107.12	39.74424700	-80.78409126	
17,300.00	89.00	150.248	11,256.05	-5,930.78	1,037.83	14,433,591.84	1,701,156.73	39.74400828	-80.78391549	
17,400.00	89.00	150.248	11,257.79	-6,017.59	1,087.45	14,433,505.04	1,701,206.35	39.74376956	-80.78373972	
17,500.00	89.00	150.248	11,259.54	-6,104.39	1,137.06	14,433,418.23	1,701,255.97	39.74353084	-80.78356395	
17,600.00	89.00	150.248	11,261.29	-6,191.20	1,186.68	14,433,331.43	1,701,305.59	39.74329212	-80.78338818	
17,700.00	89.00	150.248	11,263.03	-6,278.00	1,236.30	14,433,244.62	1,701,355.20	39.74305340	-80.78321242	
17,800.00	89.00	150.248	11,264.78	-6,364.81	1,285.92	14,433,157.82	1,701,404.82	39.74281468	-80.78303665	
17,900.00	89.00	150.248	11,266.53	-6,451.61	1,335.53	14,433,071.02	1,701,454.44	39.74257596	-80.78286089	
18,000.00	89.00	150.248	11,268.28	-6,538.42	1,385.15	14,432,984.21	1,701,504.06	39.74233724	-80.78268513	
18,100.00	89.00	150.248	11,270.02	-6,625.22	1,434.77	14,432,897.41	1,701,553.67	39.74209852	-80.78250937	
18,200.00	89.00	150.248	11,271.77	-6,712.03	1,484.39	14,432,810.60	1,701,603.29	39.74185980	-80.78233361	
18,300.00	89.00	150.248	11,273.52	-6,798.83	1,534.00	14,432,723.80	1,701,652.91	39.74162108	-80.78215785	
18,400.00	89.00	150.248	11,275.26	-6,885.64	1,583.62	14,432,636.99	1,701,702.53	39.74138235	-80.78198209	
18,500.00	89.00	150.248	11,277.01	-6,972.44	1,633.24	14,432,550.19	1,701,752.14	39.74114363	-80.78180633	
18,600.00	89.00	150.248	11,278.76	-7,059.24	1,682.86	14,432,463.38	1,701,801.76	39.74090491	-80.78163058	
18,700.00	89.00	150.248	11,280.51	-7,146.05	1,732.47	14,432,376.58	1,701,851.38	39.74066619	-80.78145483	
18,800.00	89.00	150.248	11,282.25	-7,232.85	1,782.09	14,432,289.78	1,701,901.00	39.74042746	-80.78127907	
18,900.00	89.00	150.248	11,284.00	-7,319.66	1,831.71	14,432,202.97	1,701,950.61	39.74018874	-80.78110332	
19,000.00	89.00	150.248	11,285.75	-7,406.46	1,881.33	14,432,116.17	1,702,000.23	39.73995002	-80.78092757	
19,100.00	89.00	150.248	11,287.49	-7,493.27	1,930.94	14,432,029.36	1,702,049.85	39.73971129	-80.78075182	
19,200.00	89.00	150.248	11,289.24	-7,580.07	1,980.56	14,431,942.56	1,702,099.47	39.73947257	-80.78057608	
19,300.00	89.00	150.248	11,290.99	-7,666.88	2,030.18	14,431,855.75	1,702,149.08	39.73923384	-80.78040033	
19,400.00	89.00	150.248	11,292.74	-7,753.68	2,079.80	14,431,768.95	1,702,198.70	39.73899512	-80.78022459	
19,500.00	89.00	150.248	11,294.48	-7,840.49	2,129.42	14,431,682.14	1,702,248.32	39.73875639	-80.78004884	
19,600.00	89.00	150.248	11,296.23	-7,927.29	2,179.03	14,431,595.34	1,702,297.94	39.73851767	-80.77987310	
19,700.00	89.00	150.248	11,297.98	-8,014.10	2,228.65	14,431,508.54	1,702,347.55	39.73827894	-80.77969736	
19,800.00	89.00	150.248	11,299.72	-8,100.90	2,278.27	14,431,421.73	1,702,397.17	39.73804022	-80.77952162	
19,900.00	89.00	150.248	11,301.47	-8,187.70	2,327.89	14,431,334.93	1,702,446.79	39.73780149	-80.77934588	

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well McMasters S-16 HU (slot F)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1206.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1206.00ft
Site:	McMasters Shields	North Reference:	Grid
Well:	McMasters S-16 HU (slot F)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
20,000.00	89.00	150.248	11,303.22	-8,274.51	2,377.50	14,431,248.12	1,702,496.41	39.73756276	-80.77917014	
20,100.00	89.00	150.248	11,304.97	-8,361.31	2,427.12	14,431,161.32	1,702,546.02	39.73732404	-80.77899440	
20,200.00	89.00	150.248	11,306.71	-8,448.12	2,476.74	14,431,074.51	1,702,595.64	39.73708531	-80.77881867	
20,300.00	89.00	150.248	11,308.46	-8,534.92	2,526.36	14,430,987.71	1,702,645.26	39.73684658	-80.77864293	
20,400.00	89.00	150.248	11,310.21	-8,621.73	2,575.97	14,430,900.90	1,702,694.88	39.73660786	-80.77846720	
20,500.00	89.00	150.248	11,311.95	-8,708.53	2,625.59	14,430,814.10	1,702,744.49	39.73636913	-80.77829147	
20,600.00	89.00	150.248	11,313.70	-8,795.34	2,675.21	14,430,727.30	1,702,794.11	39.73613040	-80.77811574	
20,700.00	89.00	150.248	11,315.45	-8,882.14	2,724.83	14,430,640.49	1,702,843.73	39.73589167	-80.77794001	
20,800.00	89.00	150.248	11,317.20	-8,968.95	2,774.44	14,430,553.69	1,702,893.35	39.73565294	-80.77776428	
20,900.00	89.00	150.248	11,318.94	-9,055.75	2,824.06	14,430,466.88	1,702,942.96	39.73541421	-80.77758855	
21,000.00	89.00	150.248	11,320.69	-9,142.56	2,873.68	14,430,380.08	1,702,992.58	39.73517548	-80.77741283	
21,100.00	89.00	150.248	11,322.44	-9,229.36	2,923.30	14,430,293.27	1,703,042.20	39.73493676	-80.77723710	
21,200.00	89.00	150.248	11,324.18	-9,316.16	2,972.91	14,430,206.47	1,703,091.82	39.73469803	-80.77706138	
21,300.00	89.00	150.248	11,325.93	-9,402.97	3,022.53	14,430,119.66	1,703,141.43	39.73445930	-80.77688566	
21,400.00	89.00	150.248	11,327.68	-9,489.77	3,072.15	14,430,032.86	1,703,191.05	39.73422057	-80.77670994	
21,500.00	89.00	150.248	11,329.43	-9,576.58	3,121.77	14,429,946.06	1,703,240.67	39.73398183	-80.77653422	
21,600.00	89.00	150.248	11,331.17	-9,663.38	3,171.39	14,429,859.25	1,703,290.29	39.73374310	-80.77635850	
21,700.00	89.00	150.248	11,332.92	-9,750.19	3,221.00	14,429,772.45	1,703,339.90	39.73350437	-80.77618278	
21,800.00	89.00	150.248	11,334.67	-9,836.99	3,270.62	14,429,685.64	1,703,389.52	39.73326564	-80.77600707	
21,900.00	89.00	150.248	11,336.41	-9,923.80	3,320.24	14,429,598.84	1,703,439.14	39.73302691	-80.77583135	
22,000.00	89.00	150.248	11,338.16	-10,010.60	3,369.86	14,429,512.03	1,703,488.76	39.73278818	-80.77565564	
22,100.00	89.00	150.248	11,339.91	-10,097.41	3,419.47	14,429,425.23	1,703,538.37	39.73254945	-80.77547993	
22,200.00	89.00	150.248	11,341.66	-10,184.21	3,469.09	14,429,338.42	1,703,587.99	39.73231071	-80.77530422	
22,276.95	89.00	150.248	11,343.00	-10,251.01	3,507.27	14,429,271.63	1,703,626.17	39.73212700	-80.77516900	

PBHL/TD 22276.95 MD/11343.00 TVD

Design Targets										
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (usft)	Easting (usft)	Latitude	Longitude	
McMasters S-16 HU LP - hit/miss target - Shape - Point	0.00	0.000	11,161.00	-1,208.69	-1,661.33	14,438,313.93	1,698,457.59	39.75699400	-80.79347900	
McMasters S-16 HU PBI - plan hits target center - Point	0.00	0.000	11,343.00	-10,251.01	3,507.27	14,429,271.63	1,703,626.17	39.73212700	-80.77516900	

Plan Annotations					
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment	
		+N/-S (ft)	+E/-W (ft)		
1,300.00	1,300.00	0.00	0.00	KOP Begin 2°/100' build	
1,550.00	1,549.68	-5.45	-9.44	Begin 5.00° tangent	
4,009.68	4,000.00	-112.64	-195.10	Begin 2°/100' build/turn	
4,289.20	4,277.09	-122.78	-229.60	Begin 10.00° tangent	
6,647.95	6,600.00	-190.94	-633.48	Begin 2°/100' build	
7,065.86	7,004.82	-207.96	-734.34	Begin 18.36° tangent	
10,445.33	10,212.30	-385.02	-1,783.90	Begin 6°/100' build/turn	
11,339.73	10,981.24	-769.76	-1,845.98	Begin 8°/100' build/turn	
11,860.08	11,161.00	-1,208.69	-1,661.33	Begin 89.00° lateral	
22,276.95	11,343.00	-10,251.01	3,507.27	PBHL/TD 22276.95 MD/11343.00 TVD	

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Area of Review

Sources of information to Support 35CSR8 - 5.11: 9.3 et seq.

Description of process to identify potential pathways for well communication during hydraulic fracturing activities.

Data Sources Reviewed:

1. IHS Well Data service: Public nationwide data service that pulls directly from State agency Oil and Gas databases
2. Farm Maps
3. Topo Maps: Recent and older (contact WVGES)
4. Check with DPS

Contacted Devin Ducoeur 724-705-0444, dducoeur@dpslandservices.com DPS GIS (06/02/2020) to have him make maps of the wellbores with his information. DPS utilizes WVGES maps for their mapping seems it as the best publicly available. See attached map he provided.

Request maps for:

1. Wellbore with IHS All Wells Layer
2. Map with Farm lines overlain and any well spots identified on Farm Maps
3. More recent (1970s vintage) topos and older topos

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Discussion with Phil Dinterman WVGES GIS Department (7/15/2016)

- WVGES has plotted every well spot they have access to and are aware of with that contains a coordinate. 30000, 70000, and 90000 series wells are available via the WVGES online map. Some locations aren't great due to vintage and manipulation of maps through time
- 30000 series – any well drilled prior to 1929 – APIs were not assigned to original wells
- 70000 series – Well spots pulled from old Farm line maps that the WVGES has access to
- 90000 series – Any sources that the WVGES has access that shows a well spot but has no additional supporting information. DEP does not have 90000 series on their maps.
- There can be duplication between wells in the 3 series
- Phil indicated that other Operators are providing a screenshot of the WVGES map with their planned well and using that for permits