

State of West Virginia
Department of Environmental Protection - Office of Oil and Gas
Well Operator's Report of Well Work

API 47 - 051 - 02105 County Marshall District Mead
Quad Glen Easton 7.5' Pad Name Keith Stern Field/Pool Name _____
Farm name TH Exploration, LLC Well Number Keith Stern S-10HM
Operator (as registered with the OOG) Tug Hill Operating, LLC
Address 380 Southpointe Boulevard, Plaza II, Suite 200 City Canonsburg State PA Zip 15317

As Drilled location NAD 83/UTM Attach an as-drilled plat, profile view, and deviation survey
Top hole Northing 4,402,794.96 Easting 526,362.02
Landing Point of Curve Northing 4,402,401.4 Easting 526,543.5
Bottom Hole Northing 4,400,486.9 Easting 527,647.0

Elevation (ft) 741' GL Type of Well New Existing Type of Report Interim Final
Permit Type Deviated Horizontal Horizontal 6A Vertical Depth Type Deep Shallow
Type of Operation Convert Deepen Drill Plug Back Redrilling Rework Stimulate
Well Type Brine Disposal CBM Gas Oil Secondary Recovery Solution Mining Storage Other _____
Type of Completion Single Multiple Fluids Produced Brine Gas NGL Oil Other _____
Drilled with Cable Rotary

Drilling Media Surface hole Air Mud Fresh Water Intermediate hole Air Mud Fresh Water Brine
Production hole Air Mud Fresh Water Brine

Mud Type(s) and Additive(s)
SOBM; Base oil, osmotic inhibitor, weighting agent, viscosifier, emulsifier, hardness buffer, fluid loss additive, LCM, Shale inhibitor, de-foamer, soaping agent, coagulant, flocculant; specific additives per WSSP and Permit.

Date permit issued 10/22/2018 Date drilling commenced 10/3/2020 apud: 10/3/2020 big rig: 8/15/2022 Date drilling ceased 8/28/2022
Date completion activities began 12/2/2022 Date completion activities ceased 12/27/2022
Verbal plugging (Y/N) N Date permission granted n/a Granted by n/a

Please note: Operator is required to submit a plugging application within 5 days of verbal permission to plug

Freshwater depth(s) ft 440' Open mine(s) (Y/N) depths N
Salt water depth(s) ft 933' Void(s) encountered (Y/N) depths N
Coal depth(s) ft 341-347', 434-440' Cavern(s) encountered (Y/N) depths N
Is coal being mined in area (Y/N) N

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Reviewed by: [Signature]
12/08/2023
WV Department of Environmental Protection

API 47-051 - 02105 Farm name TH Exploration, LLC Well number Keith Stern S-10HM

CASING STRINGS	Hole Size	Casing Size	Depth	New or Used	Grade wt/ft	Basket Depth(s)	Did cement circulate (Y/N) * Provide details below*
Conductor	36"	30"	120'	NEW	94.5#	N/A	Y
Surface	17 1/2"	13 3/8"	536'	NEW	54.5#	N/A	Y
Coal	17 1/2"	13 3/8"	536'	NEW	54.5#	N/A	Y
Intermediate 1	12 1/4"	9 5/8"	2,261'	NEW	36#	N/A	Y
Intermediate 2							
Intermediate 3							
Production	8 3/4"	5 1/2"	13,979'	NEW	20#	N/A	Y
Tubing		2 7/8"	6,990'	NEW	4.7#	N/A	Y
Packer type and depth set							

Comment Details _____

CEMENT DATA	Class/Type of Cement	Number of Sacks	Slurry wt (ppg)	Yield (ft ³ /sks)	Volume (ft ³)	Cement Top (MD)	WOC (hrs)
Conductor	A	65	15.6	1.21	78	0	8
Surface	A	800	15.6	1.2	960	0	8
Coal	A	800	15.6	1.2	960	0	8
Intermediate 1	A	760	15	1.38	1048.8	0	8
Intermediate 2							
Intermediate 3							
Production	A	3155	14.5	1.23	3880.65	0	8
Tubing							

Drillers TD (ft) 14,011' Loggers TD (ft) n/a
 Deepest formation penetrated Marcellus Plug back to (ft) n/a
 Plug back procedure n/a

Kick off depth (ft) 6,034'

Check all wireline logs run caliper density deviated/directional induction
 neutron resistivity gamma ray temperature sonic

Well cored Yes No Conventional Sidewall Were cuttings collected Yes No

DESCRIBE THE CENTRALIZER PLACEMENT USED FOR EACH CASING STRING 3 centralizers on surface casing at equal distance.
Intermediate - 1 centralizer every other joint.
 Production - one centralizer every other joint in lateral, one centralizer every joint through curve, one centralizer every other joint to surface.

WAS WELL COMPLETED AS SHOT HOLE Yes No DETAILS _____

WAS WELL COMPLETED OPEN HOLE? Yes No DETAILS _____

WERE TRACERS USED Yes No TYPE OF TRACER(S) USED _____

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**KEITH STERN S-10HM
PERFORATION RECORD**

Stage No.	Perforation Date	Perforated from MD ft.	Perforated to MD. Ft.	Number of Perforations	Formation(s)
1	12/2/2022	13,788	13,837	30	MARCELLUS
2	12/3/2022	13,586	13,733	30	MARCELLUS
3	12/5/2022	13,409	13,557	30	MARCELLUS
4	12/5/2022	13,233	13,380	30	MARCELLUS
5	12/6/2022	13,056	13,203	30	MARCELLUS
6	12/7/2022	12,879	13,026	30	MARCELLUS
7	12/7/2022	12,703	12,850	30	MARCELLUS
8	12/8/2022	12,526	12,673	30	MARCELLUS
9	12/8/2022	12,349	12,496	30	MARCELLUS
10	12/9/2022	12,172	12,320	30	MARCELLUS
11	12/9/2022	11,996	12,143	30	MARCELLUS
12	12/10/2022	11,819	11,966	30	MARCELLUS
13	12/10/2022	11,642	11,790	30	MARCELLUS
14	12/11/2022	11,466	11,613	30	MARCELLUS
15	12/11/2022	11,289	11,436	30	MARCELLUS
16	12/12/2022	11,112	11,259	30	MARCELLUS
17	12/13/2022	10,936	11,083	30	MARCELLUS
18	12/13/2022	10,759	10,906	30	MARCELLUS
19	12/14/2022	10,582	10,729	30	MARCELLUS
20	12/15/2022	10,405	10,552	30	MARCELLUS
21	12/15/2022	10,229	10,375	30	MARCELLUS
22	12/16/2022	10,052	10,198	30	MARCELLUS
23	12/16/2022	9,875	10,021	30	MARCELLUS
24	12/17/2022	9,699	9,844	30	MARCELLUS
25	12/17/2022	9,522	9,667	30	MARCELLUS
26	12/18/2022	9,345	9,490	30	MARCELLUS
27	12/18/2022	9,169	9,313	30	MARCELLUS
28	12/19/2022	8,992	9,136	30	MARCELLUS
29	12/19/2022	8,815	8,959	30	MARCELLUS
30	12/20/2022	8,638	8,782	30	MARCELLUS
31	12/20/2022	8,461	8,605	30	MARCELLUS
32	12/21/2022	8,284	8,428	30	MARCELLUS
33	12/21/2022	8,107	8,251	30	MARCELLUS
34	12/22/2022	7,930	8,074	30	MARCELLUS
35	12/22/2022	7,753	7,897	30	MARCELLUS
36	12/23/2022	7,576	7,720	30	MARCELLUS
37	12/25/2022	7,399	7,543	30	MARCELLUS
38	12/26/2022	7,222	7,366	30	MARCELLUS
39	12/26/2022	7,045	7,189	30	MARCELLUS
40	12/27/2022	6,868	7,012	30	MARCELLUS
41	12/27/2022	6,691	6,835	30	MARCELLUS

**KEITH STERN S-10HM
STIMULATION INFORMATION PER STAGE**

Stage No.	Ave. Pump Rate (BPM)	Ave Treatment Pressure (PSI)	Max Breakdown Pressure (PSI)	ISIP (PSI)	Amount of Proppant (lbs)	Amount of Water (bbls)	Amount of Nitrogen/other (lbs)
1	73.00	8287		3517	254860	8,696	0
2	89.00	7971	5436	4630	403700	7,895	0
3	85.00	7368	5640	5208	446320	8,395	0
4	88.00	7288	5435	5016	445560	8,253	0
5	90.00	7156	5280	5228	446560	8,131	0
6	87.00	7075	5340	5270	448020	8,516	0
7	88.00	7113	5381	384	446700	8,239	0
8	88.00	7162	5362	5156	443240	8,211	0
9	89.00	7001	5485	4869	448360	8,494	0
10	85.00	6777	5525	5034	443400	8,471	0
11	88.00	6917	5744	5025	447720	8,549	0
12	89.00	7144	5655	5243	438600	7,963	0
13	89.00	7062	5171	4986	441360	8,289	0
14	89.00	7137	5702	5354	447400	7,952	0
15	90.00	6925	5525	5318	448680	8,217	0
16	89.00	6885	5528	5291	448240	7,850	0
17	90.00	7091	5517	5414	448100	7,767	0
18	90.00	6825	5426	5060	446600	8,063	0
19	88.00	7024	5448	5334	449480	8,419	0
20	89.00	6947	5432	5239	444520	7,647	0
21	88.00	6995	5201	5081	446900	8,369	0
22	91.00	7037	6421	5094	444700	7,786	0
23	88.00	6824	5315	4664	444100	8,118	0
24	90.00	6995	5413	5121	444220	7,897	0
25	88.00	6968	5490	5369	437300	7,850	0
26	90.00	6852	5622	5198	448660	7,770	0
27	89.00	6793	5886	5317	439500	7,579	0
28	89.00	6722	5871	5300	442280	8,055	0
29	90.00	6859	5611	4832	446700	8,072	0
30	89.00	6765	5026	4838	442300	7,580	0
31	90.00	6577	5384	5178	448840	7,869	0
32	89.00	6757	5299	5002	444230	8,078	0

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Stage No.	Ave. Pump Rate (BPM)	Ave Treatment Pressure (PSI)	Max Breakdown Pressure (PSI)	ISIP (PSI)	Amount of Proppant (lbs)	Amount of Water (bbls)	Amount of Nitrogen/other (units)
33	87.00	6516	166	5159	447560	7,989	0
34	89.00	6528	5003	5264	448220	8,129	0
35	90.00	6451	5489	4957	449020	8,185	0
36	90.00	6602	4837	4661	442378	8,016	0
37	88.00	6409	5113	4973	442420	8,005	0
38	86.00	6345	148	5034	440320	7,999	0
39	90.00	6581	5522	4958	447800	8,144	0
40	87.00	6417	5302	5024	445266	8,060	0
41	88.00	6373	5662	5323	444620	7,884	0

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KEITH STERN S-10HM

LITHOLOGY/FORMATION	TOP DEPTH IN FT/ Name TVD	BOTTOM DEPTH IN FT TVD	TOP DEPTH IN FT MD	BOTTOM DEPTH IN FT MD	DESCRIBE ROCK TYPE AND RECORD QUANTITY AND TYPE OF FLUID
Maxton	1530	1704	1530	1705	Sandstone
Big Lime	1704	1770	1705	1771	Limestone
Big Injun	1770	1988	1771	1990	Sandstone
Weir	1988	2191	1990	2194	Sandstone
Berea	2191	2454	2194	2458	Sandstone
Gordon	2454	2534	2458	2538	Sandstone
Fifty Foot	2534	3116	2538	3123	Sandstone
Speechley	3116	4597	3123	4618	Sandstone
Benson	4597	4972	4618	5018	Sandstone
Alexander	4972	5600	5018	5703	Siltstone
Rhinestreet	5600	6052	5703	6203	Black Shale
Middlesex	6052	6123	6203	6295	Black Shale
Geneseo/Burkett	6123	6156	6295	6342	Black Shale
Tully	6156	6181	6342	6381	Limestone
Hamilton	6181	6266	6381	6566	Gray Shale
Marcellus	6266	-	6566	-	Black Shale

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Hydraulic Fracturing Fluid Product Component Information Disclosure

Job Start Date:	12/2/2022
Job End Date:	12/28/2022
State:	West Virginia
County:	Marshall
API Number:	47-051-02105-00-00
Operator Name:	Tug Hill Operating, LLC
Well Name and Number:	Keith Stern S-10HM
Latitude:	39.77469000
Longitude:	-80.69217900
Datum:	NAD27
Federal Well:	NO
Indian Well:	NO
True Vertical Depth:	6,440
Total Base Water Volume (gal):	14,629,566
Total Base Non Water Volume:	0



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Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
Water	Tug Hill Operating	Carrier/Base Fluid	Water	7732-18-5	100.00000	87.84271	None
			Silica Substrate	14808-60-7	100.00000	11.79055	None
Hydrochloric Acid (7.5%)	Producers Service Corp.	Acidizing	Water	7732-18-5	85.00000	0.23299	None
			Hydrochloric Acid (Hydrogen Chloride)	7647-01-0	37.00000	0.10142	None
StimStream FR 9800	Chemstream	Friction Reducer	Butene, homopolymer	9003-29-6	25.00000	0.02083	None
			Alkanes, C16-20-iso-	90622-59-6	25.00000	0.02083	None
			Ethoxylated alcohols (C12-18)	68213-23-0	3.00000	0.00250	None
LD-7750W	Multi-Chem	Scale Inhibitor	Methanol	67-56-1	60.00000	0.00527	None
			Phosphonic Acid Salt	Proprietary	5.00000	0.00044	None
4-N-1	Producers Service Corp.	Corrosion Inhibitor	Acetic acid	64-19-7	90.00000	0.00049	None

			2-Ethylhexanol	104-76-7	10.00000	0.00005	None
			Methanol	67-56-1	10.00000	0.00005	None
			Cocamide Diethanolamine	68603-42-9	5.00000	0.00003	None
			Diethanolamine	111-42-2	1.00000	0.00001	None
Ingredients shown above are subject to 29 CFR 1910.1200(i) and appear on Material Safety Data Sheets (MSDS). Ingredients shown below are Non-MSDS.							
Other Chemical(s)	Listed Above	See Trade Name(s) List					
			Hydrochloric Acid (Hydrogen Chloride)	7647-01-0	37.00000	0.10142	
			Alkanes, C16-20-iso-	90622-59-6	25.00000	0.02083	
			Ethoxylated alcohols (C12-18)	68213-23-0	3.00000	0.00250	
			Phosphonic Acid Salt	Proprietary	5.00000	0.00044	
			Methanol	67-56-1	10.00000	0.00005	
			2-Ethylhexanol	104-76-7	10.00000	0.00005	
			Cocamide Diethanolamine	68603-42-9	5.00000	0.00003	
			Diethanolamine	111-42-2	1.00000	0.00001	

* Total Water Volume sources may include fresh water, produced water, and/or recycled water

** Information is based on the maximum potential for concentration and thus the total may be over 100%

Note: For Field Development Products (products that begin with FDP), MSDS level only information has been provided.

Ingredient information for chemicals subject to 29 CFR 1910.1200(i) and Appendix D are obtained from suppliers Material Safety Data Sheets (MSDS)

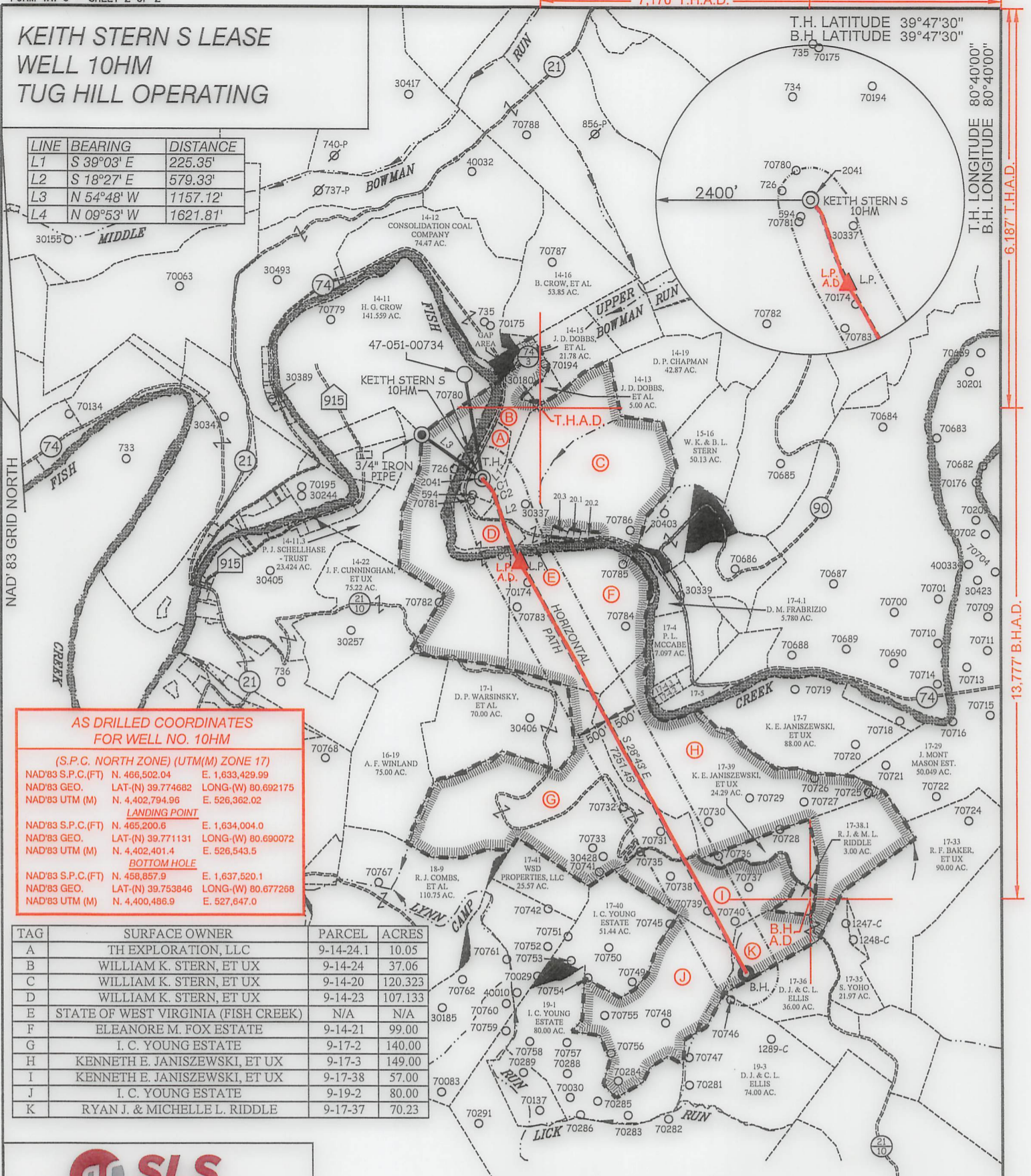
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KEITH STERN S LEASE WELL 10HM TUG HILL OPERATING

LINE	BEARING	DISTANCE
L1	S 39°03' E	225.35'
L2	S 18°27' E	579.33'
L3	N 54°48' W	1157.12'
L4	N 09°53' W	1621.81'



**AS DRILLED COORDINATES
FOR WELL NO. 10HM**

(S.P.C. NORTH ZONE) (UTM(M) ZONE 17)

NAD'83 S.P.C.(FT)	N. 466,502.04	E. 1,633,429.99
NAD'83 GEO.	LAT-(N) 39.774682	LONG-(W) 80.692175
NAD'83 UTM (M)	N. 4,402,794.96	E. 526,362.02

LANDING POINT

NAD'83 S.P.C.(FT)	N. 465,200.6	E. 1,634,004.0
NAD'83 GEO.	LAT-(N) 39.771131	LONG-(W) 80.690072
NAD'83 UTM (M)	N. 4,402,401.4	E. 526,543.5

BOTTOM HOLE

NAD'83 S.P.C.(FT)	N. 458,857.9	E. 1,637,520.1
NAD'83 GEO.	LAT-(N) 39.753846	LONG-(W) 80.677268
NAD'83 UTM (M)	N. 4,400,486.9	E. 527,647.0

TAG	SURFACE OWNER	PARCEL	ACRES
A	TH EXPLORATION, LLC	9-14-24.1	10.05
B	WILLIAM K. STERN, ET UX	9-14-24	37.06
C	WILLIAM K. STERN, ET UX	9-14-20	120.323
D	WILLIAM K. STERN, ET UX	9-14-23	107.133
E	STATE OF WEST VIRGINIA (FISH CREEK)	N/A	N/A
F	ELEANORE M. FOX ESTATE	9-14-21	99.00
G	I. C. YOUNG ESTATE	9-17-2	140.00
H	KENNETH E. JANISZEWSKI, ET UX	9-17-3	149.00
I	KENNETH E. JANISZEWSKI, ET UX	9-17-38	57.00
J	I. C. YOUNG ESTATE	9-19-2	80.00
K	RYAN J. & MICHELLE L. RIDDLE	9-17-37	70.23



12 Vanhorn Drive | P.O. Box 150 | Glenview, WV 26351 | 304.462.5634
 1412 Kanawha Boulevard, East | Charleston, WV 25301 | 304.346.3952
 254 East Beckley Bypass | Beckley, WV 25801 | 304.255.5296
 slsww.com

CURVE	ARC LENGTH	RADIUS	CHORD BEARING	CHORD LENGTH
C1	70.65'	328.42'	S 26°52' E	70.52'
C2	68.31'	1574.23'	S 21°02' E	68.30'
C3	490.12'	4316.88'	S 26°02' E	489.85'

(S.P.C. NORTH ZONE) (UTM(M) ZONE 17)

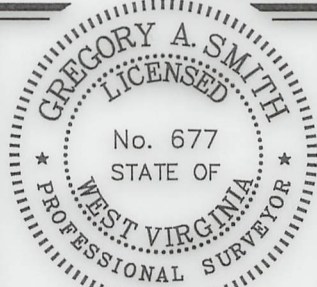
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NAD'83 UTM (M)	N. 4,402,794.96	E. 526,362.02

LANDING POINT

NAD'83 S.P.C.(FT)	N. 465,210.7	E. 1,634,026.6
NAD'83 GEO.	LAT-(N) 39.771159	LONG-(W) 80.689992
NAD'83 UTM (M)	N. 4,402,404.6	E. 526,550.4

BOTTOM HOLE

NAD'83 S.P.C.(FT)	N. 458,851.3	E. 1,637,511.3
NAD'83 GEO.	LAT-(N) 39.753828	LONG-(W) 80.677299
NAD'83 UTM (M)	N. 4,400,484.9	E. 527,644.3



(+) DENOTES LOCATION OF WELL ON UNITED STATES TOPOGRAPHIC MAPS.

P.S.
677

Gregory A. Smith

LEGEND

- LEASE LINE
- SURFACE LINE
- WELL LATERAL
- OFFSET LINE
- TIE LINE
- CREEK
- ROAD
- COUNTY ROUTE
- PROPOSED WELL
- EXISTING WELL
- PERMITTED WELL
- TAX MAP-PARCEL 00-00
- LEASE # (SEE WW-6A1)
- SURFACE OWNER (SEE TABLE) A

SCALE 1" = 2000' FILE NO. 8811P10HMv2-AD.dwg

DATE FEBRUARY 15, 2023

REVISED _____, 20____

OPERATORS WELL NO. KEITH STERN S-10HM

API WELL NO. 47 - 051 - 02105
 STATE COUNTY PERMIT

STATE OF WEST VIRGINIA
 DIVISION OF
 ENVIRONMENTAL PROTECTION
 OFFICE OF OIL AND GAS



DESIGNATED AGENT DARREN BROWN - CT CORPORATION
 ADDRESS 5098 WASHINGTON ST. W, STE 407
 CHARLESTON, WV 25313-1561

WELL OPERATOR TUG HILL OPERATING, LLC
 ADDRESS 1320 SOUTH UNIVERSITY DRIVE, SUITE 500
 FORT WORTH, TX 76107

COUNTY NAME PERMIT

7,170' T.H.A.D.

2,981' B.H.A.D.

**KEITH STERN S LEASE
WELL 10HM
TUG HILL OPERATING**

T.H. LATITUDE 39°47'30"
B.H. LATITUDE 39°47'30"

T.H. LONGITUDE 80°40'00"
B.H. LONGITUDE 80°40'00"

(S.P.C. NORTH ZONE) (UTM(M) ZONE 17)

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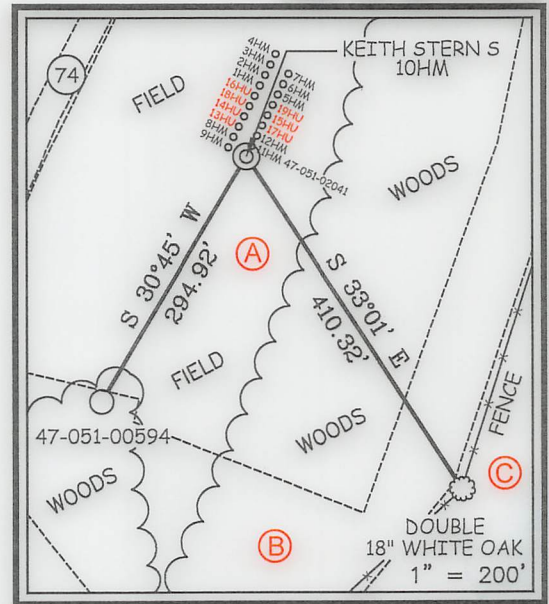
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NAD'83 UTM (M) N. 4,400,484.9 E. 527,644.3

TAX MAP/PCL	ADJOINING SURFACE OWNER	ACRES
14-20.1	WILLIAM K. STERN, ET UX	1.321
14-20.2	WILLIAM K. STERN, ET UX	1.525
14-20.3	WILLIAM K. STERN, ET UX	0.831
17-4.2	RICKY E. DAVIS	1.301
17-4.3	SYLVIA JEAN NEEHOUSE	1.329
17-5	KENNETH E. JANISZEWSKI, ET UX	5.00

REFERENCES



T.H.A.D.

B.H. A.D.

NOTES ON SURVEY

1. NO WATER WELLS WERE FOUND WITHIN 250' OF PROPOSED GAS WELL. NO AGRICULTURAL BUILDINGS OR DWELLINGS > 2500 SQ. FT. WERE FOUND WITHIN 625' OF THE CENTER OF PROPOSED WELL PAD.
2. WELL SPOT CIRCLE & TOPO MARK SCALE IS 1"=2000'.
3. PLAT UPDATED TO SHOW AS-DRILLED PATH.
4. AS DRILLED DATA PROVIDED BY TUG HILL OPERATING.



12 Vanhorn Drive | P.O. Box 150 | Glenville, WV 26351 | 304.462.5634
1412 Kanawha Boulevard, East | Charleston, WV 25301 | 304.346.3952
254 East Beckley Bypass | Beckley, WV 25801 | 304.255.5296
slswv.com

I THE UNDERSIGNED, HEREBY CERTIFY THAT THIS PLAT IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF AND SHOWS ALL THE INFORMATION REQUIRED BY LAW AND THE REGULATIONS ISSUED AND PRESCRIBED BY THE DIVISION OF ENVIRONMENTAL PROTECTION.

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Gregory A. Smith



(+) DENOTES LOCATION OF WELL ON UNITED STATES TOPOGRAPHIC MAPS.

DATE FEBRUARY 15, 20 23

REVISED _____, 20 _____

OPERATORS WELL NO. KEITH STERN S-10HM

API WELL NO. 47 - 051 - 02105

STATE COUNTY PERMIT

MINIMUM DEGREE OF ACCURACY 1 / 2500 FILE NO. 8811P10HMv2-AD.dwg SCALE 1" = 2000'

HORIZONTAL & VERTICAL CONTROL DETERMINED BY DGPS (SURVEY GRADE TIE TO CORS NETWORK)

STATE OF WEST VIRGINIA
DIVISION OF ENVIRONMENTAL PROTECTION
OFFICE OF OIL AND GAS



WELL TYPE: OIL _____ GAS INJECTION _____ WASTE DISPOSAL _____ IF "GAS" PRODUCTION STORAGE _____ DEEP _____ SHALLOW

LOCATION: GROUND = 741.00' ELEVATION PROPOSED = 744.65' WATERSHED FISH CREEK (HUC 10)

DISTRICT MEADE COUNTY MARSHALL QUADRANGLE GLEN EASTON 7.5'

SURFACE OWNER TH EXPLORATION, LLC ACREAGE 10.05±

ROYALTY OWNER ISAAC CROW, ET AL - SEE WW-6A1 ACREAGE 12.08/2023

PROPOSED WORK: DRILL CONVERT _____ DRILL DEEPER _____ REDRILL _____ FRACTURE OR STIMULATE PLUG OFF OLD FORMATION _____ PERFORATE NEW FORMATION _____ PLUG AND ABANDON _____ CLEAN OUT AND REPLUG _____ OTHER _____

PHYSICAL CHANGE IN WELL (SPECIFY) _____ TARGET FORMATION MARCELLUS ESTIMATED DEPTH TVD: 6,405' / TMD: 13,996'

WELL OPERATOR TUG HILL OPERATING, LLC DESIGNATED AGENT DARREN BROWN - CT CORPORATION
ADDRESS 1320 SOUTH UNIVERSITY DRIVE, SUITE 500 FORT WORTH, TX 76107 ADDRESS 5098 WASHINGTON ST. W, STE 407 CHARLESTON, WV 25313-1561

COUNTY NAME PERMIT