west virginia department of environmental protection

Office of Oil and Gas
601 57th Street SE
Charleston, WV 25304
(304) 926-0450
(304) 926-0452 fax

Earl Ray Tomblin, Governor
Randy C. Huffman, Cabinet Secretary
www.dep.wv.gov

PERMIT MODIFICATION APPROVAL

November 02, 2015

ANTERO RESOURCES CORPORATION
1615 WYNKOOP STREET
DENVER, CO 80202

Re: Permit Modification Approval for API Number 8510178, Well #: JACKKNIFE UNIT 1H

Move Surface Hole Location

Oil and Gas Operator:
The Office of Oil and Gas has reviewed the attached permit modification for the above referenced permit. The attached modification has been approved and well work may begin. Please be reminded that the oil and gas inspector is to be notified twenty-four (24) hours before permitted well work is commenced.

Please call James Martin at 304-926-0499, extension 1654 if you have any questions.

Sincerely,

Taylor Brewer For

Gene Smith
Assistant Chief of Permitting
Office of Oil and Gas

Antero Resources
1615 Wynkoop Street
Denver, CO 80202
Office 303.357.7310
Fax 303.357.7315

October 21, 2015

West Virginia Department of Environmental Protection
Office of Oil and Gas
Attn: Mr. Taylor Brewer
601 57th Street
Charleston, WV 25304

Mr. Brewer:

Antero Resources Corporation (Antero) would like to submit the following permit modifications for two approved wells on the Buck Run pad. We are requesting to slightly change the surface hole locations of the Jackknife Unit 1H (API# 47-085-10178) and Jackknife Unit 2H (API# 47-085-10179). The location of the Buck Run pad will not change from what was originally approved, and there will be no additional disturbance associated with these requested modifications. Please note that there are no Coal Owners or Declarations on record with Ritchie County at this pad location; therefore, no notifications are required.

Attached you will find the following documents:

- REVISED Mylar Plats, which shows the new surface hole locations
- Form WW-6B – no change to approved casing plan

If you have any questions please feel free to contact me at (303) 357-7323.

4708510178 Mod

Thank you in advance for your consideration.

Sincerely,

Ashlie Steele

Ashlie Steele
Permitting Supervisor
Antero Resources Corporation

Enclosures

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OCT 22 2015
WV Department of
Environmental Protection

API# 47-085-10178 MODIFICATION

WW-6B
(04/15)

API NO. 47- 085 - 10178
OPERATOR WELL NO. Jackknife Unit 1H
Well Pad Name: Buck Run Pad

STATE OF WEST VIRGINIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS
WELL WORK PERMIT APPLICATION

1) Well Operator:	Antero Resources Corporat	494488557	085 - Ritchie	Clay	Pennsboro 7.5'
		Operator ID	County	District	Quadrangle

2) Operator's Well Number: Jackknife Unit 1H Well Pad Name: Buck Run Pad

3) Farm Name/Surface Owner: Stephen C. Jackson, et al Public Road Access: CR 74/9

4) Elevation, current ground: 1163' Elevation, proposed post-construction: 1127'

5) Well Type (a) Gas X Oil _____ Underground Storage _____
Other _____
(b)If Gas Shallow X Deep _____
Horizontal X

6) Existing Pad: Yes or No No

4708510178 Mod

7) Proposed Target Formation(s), Depth(s), Anticipated Thickness and Expected Pressure(s):
Marcellus Shale: 6500' TVD, Anticipated Thickness- 75 feet, Associated Pressure- 2800#

8) Proposed Total Vertical Depth: 6500' TVD

9) Formation at Total Vertical Depth: Marcellus Shale

10) Proposed Total Measured Depth: 16,300' MD

11) Proposed Horizontal Leg Length: 9293'

12) Approximate Fresh Water Strata Depths: 115', 244', 462'

13) Method to Determine Fresh Water Depths: Offset well records. Depths have been adjusted according to surface elevations.

14) Approximate Saltwater Depths: 532', 1149', 1794'

15) Approximate Coal Seam Depths: 420', 557', 757'

16) Approximate Depth to Possible Void (coal mine, karst, other): None Anticipated

17) Does Proposed well location contain coal seams directly overlying or adjacent to an active mine? Yes _____ No X

(a) If Yes, provide Mine Info: Name: _____
Depth: _____
Seam: _____
Owner: _____

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API# 47-085-10178 MODIFICATION

WW-6B
(04/15)

API NO. 47- 085 - 10178
OPERATOR WELL NO. Jackknife Unit 1H
Well Pad Name: Buck Run Pad

18) **CASING AND TUBING PROGRAM**

TYPE	Size (in)	New or Used	Grade	Weight per ft. (lb/ft)	FOOTAGE: For Drilling (ft)	INTERVALS: Left in Well (ft)	CEMENT: Fill-up (Cu. Ft.)/CTS
Conductor	20"	New	H-40	94#	40'	40'	CTS, 38 Cu. Ft.
Fresh Water	13-3/8"	New	J-55/H-40	54.5#/48#	515'	515' *see #19	CTS, 715 Cu. Ft.
Coal	9-5/8"	New	J-55	36#	2455'	2455'	CTS, 1000 Cu. Ft.
Intermediate							
Production	5-1/2"	New	P-110	20#	16,300'	16,300'	CTS, 4088 Cu. Ft
Tubing	2-3/8"	New	N-80	4.7#		7100'	
Liners							

TYPE	Size (in)	Wellbore Diameter (in)	Wall Thickness (in)	Burst Pressure (psi)	Anticipated Max. Internal Pressure (psi)	Cement Type	Cement Yield (cu. ft./k)
Conductor	30"	24"	0.438"	1530	50	Class A	1.18
Fresh Water	13-3/8"	17-1/2"	0.38"/0.33"	2730/1730	1000	Class A	1.18
Coal	9-5/8"	12-1/4"	0.352"	3520	1500	Class A	1.18
Intermediate							
Production	5-1/2"	8-3/4" & 8-1/2"	0.361"	12,630	2500	Lead-H/POZ & Tail - H	H/POZ-1.44 & H-1.8
Tubing	2-3/8"	4.778"	0.19"	11,200			
Liners							

PACKERS 4708510178 MOD

Kind:	N/A			
Sizes:	N/A			
Depths Set:	N/A			

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Environmental Protection

WW-6B
(10/14)

API NO. 47- 085 - 10178
OPERATOR WELL NO. Jackknife Unit 1H
Well Pad Name: Buck Run Pad

19) Describe proposed well work, including the drilling and plugging back of any pilot hole:

Drill, perforate, fracture a new horizontal shallow well and complete Marcellus Shale.
*Antero will be air drilling the fresh water string which makes it difficult to determine when freshwater is encountered, therefore we have built in a buffer for the casing setting depth which helps to ensure that all fresh water zones are covered.

20) Describe fracturing/stimulating methods in detail, including anticipated max pressure and max rate:

Antero plans to pump Slickwater into the Marcellus Shale formation in order to ready the well for production. The fluid will be comprised of approximately 99 percent water and sand, with less than 1 percent special-purpose additives as shown in the attached "List of Anticipated Additives Used for Fracturing or Stimulating Well."

Anticipated Max Pressure - 9300 lbs
Anticipated Max Rate - 80 bpm

21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 28.54 acres

22) Area to be disturbed for well pad only, less access road (acres): 10.27 acres

4708510178 MOD

23) Describe centralizer placement for each casing string:

Conductor: no centralizers
Surface Casing: one centralizer 10' above the float shoe, one on the insert float collar and one every 4th joint spaced up the hole to surface.
Intermediate Casing: one centralizer above float joint, one centralizer 5' above float collar and one every 4th collar to surface.
Production Casing: one centralizer at shoe joint and one every 3 joints to top of cement in intermediate casing.

24) Describe all cement additives associated with each cement type:

Conductor: no additives, Class A cement.
Surface: Class A cement with 2-3% calcium chloride and 1/4 lb of flake
Intermediate: Class A cement with 1/4 lb of flake, 5 gallons of clay treat
Production: Lead cement- 50/50 Class H/Poz + 1.5% salt + 1% C-45 + 0.5% C-16a + 0.2% C-12 + 0.45% C-20 + 0.05% C-51
Production: Tail cement- Class H + 45 PPS Calcium Carbonate + 1.0% FL-160 + 0.2% ACGB-47 + 0.05% ACSA-51 + 0.2% ACR-20

25) Proposed borehole conditioning procedures:

Conductor: blowhole clean with air, run casing, 10 bbls fresh water.
Surface: blowhole clean with air, trip to conductor shoe, trip to bottom, blowhole clean with air, trip out, run casing, circulate pipe capacity + 40 bbls fresh water followed by 25 bbls bentonite mud, 10 bbls fresh water spacer.
Intermediate: blowhole clean with air, trip to surface casing shoe, trip to bottom, blowhole clean with air, trip out, run casing, circulate 40 bbls brine water followed by 10 bbls fresh water and 25 bbls bentonite mud, pump 10 bbls fresh water.
Production: circulate with 14 lb/gal NaCl mud, trip to middle of lateral, circulate, pump high viscosity sweep, trip to base of curve, pump high viscosity sweep, trip to top of curve, trip to bottom, circulate, pump high viscosity sweep, trip out, run casing, circulate (10 bbls fresh water) pump 48 bbls barite pill, pump 10 bbls fresh water followed by 48 bbls mud flush and 10 bbls water.

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*Note: Attach additional sheets as needed.

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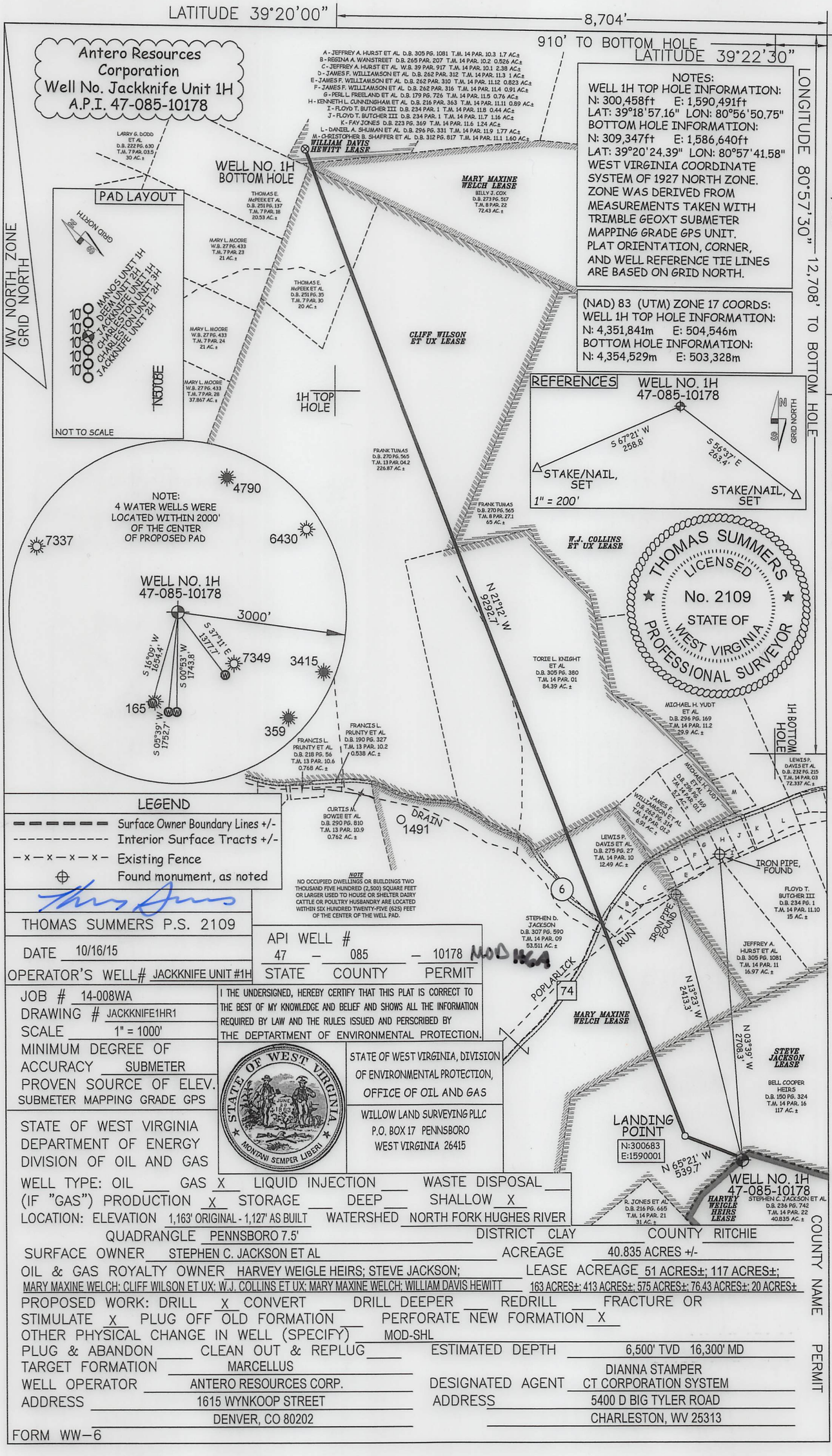
LATITUDE 39°20'00"
8,704'
910' TO BOTTOM HOLE
LATITUDE 39°22'30"
LONGITUDE 80°57'30"
12,708' TO BOTTOM HOLE
6,358'
LONGITUDE 80°55'00"
Antero Resources Corporation
Well No. Jackknife Unit 1H
A.P.I. 47-085-10178
NOTES:
WELL 1H TOP HOLE INFORMATION:
N: 300,458ft E: 1,590,491ft
LAT: 39°18'57.16" LON: 80°56'50.75"
BOTTOM HOLE INFORMATION:
N: 309,347ft E: 1,586,640ft
LAT: 39°20'24.39" LON: 80°57'41.58"
WEST VIRGINIA COORDINATE SYSTEM OF 1927 NORTH ZONE.
ZONE WAS DERIVED FROM MEASUREMENTS TAKEN WITH TRIMBLE GEOXT SUBMETER MAPPING GRADE GPS UNIT.
PLAT ORIENTATION, CORNER, AND WELL REFERENCE TIE LINES ARE BASED ON GRID NORTH.
(NAD) 83 (UTM) ZONE 17 COORDS:
WELL 1H TOP HOLE INFORMATION:
N: 4,351,841m E: 504,546m
BOTTOM HOLE INFORMATION:
N: 4,354,529m E: 503,328m
A - JEFFREY A. HURST ET AL D.B. 305 PG. 1081 T.M. 14 PAR. 10.3 1.7 AC±
B - REGINA A. WANSTREET D.B. 265 PAR. 207 T.M. 14 PAR. 10.2 0.526 AC±
C - JEFFREY A. HURST ET AL W.B. 39 PAR. 917 T.M. 14 PAR. 10.1 2.38 AC±
D - JAMES F. WILLIAMSON ET AL D.B. 262 PAR. 312 T.M. 14 PAR. 11.3 1 AC±
E - JAMES F. WILLIAMSON ET AL D.B. 262 PAR. 310 T.M. 14 PAR. 11.12 0.823 AC±
F - JAMES F. WILLIAMSON ET AL D.B. 262 PAR. 316 T.M. 14 PAR. 11.4 0.91 AC±
G - PEARL L. FREELAND ET AL D.B. 179 PG. 726 T.M. 14 PAR. 11.5 0.76 AC±
H - KENNETH L. CUNNINGHAM ET AL D.B. 216 PAR. 363 T.M. 14 PAR. 11.11 0.89 AC±
I - FLOYD T. BUTCHER III D.B. 234 PAR. 1 T.M. 14 PAR. 11.8 0.44 AC±
J - FLOYD T. BUTCHER III D.B. 234 PAR. 1 T.M. 14 PAR. 11.7 1.16 AC±
K - FAY JONES D.B. 223 PG. 369 T.M. 14 PAR. 11.6 1.24 AC±
L - DANIEL A. SHUMAN ET AL D.B. 296 PG. 331 T.M. 14 PAR. 11.9 1.77 AC±
M - CHRISTOPHER B. SHAFFER ET AL D.B. 312 PG. 817 T.M. 14 PAR. 11.1 1.60 AC±
WILLIAM DAVIS HEWITT LEASE
WELL NO. 1H BOTTOM HOLE
MARY MAXINE WELCH LEASE
BILLY J. COX D.B. 273 PG. 517 T.M. 8 PAR. 22 72.43 AC.±
LARRY G. DODD ET AL D.B. 222 PG. 630 T.M. 7 PAR. 03.5 30 AC.±
THOMAS E. McPEEK ET AL D.B. 251 PG. 137 T.M. 7 PAR. 18 20.53 AC.±
MARY L. MOORE W.B. 27 PG. 433 T.M. 7 PAR. 23 21 AC.±
THOMAS E. McPEEK ET AL D.B. 251 PG. 35 T.M. 7 PAR. 30 20 AC.±
MARY L. MOORE W.B. 27 PG. 433 T.M. 7 PAR. 24 21 AC.±
MARY L. MOORE W.B. 27 PG. 433 T.M. 7 PAR. 28 37.867 AC.±
CLIFF WILSON ET UX LEASE
1H TOP HOLE
PAD LAYOUT
GRID NORTH
MANOS UNIT 1H
DEER UNIT 2H
JACKKNIFE UNIT 1H
CHARLESTON UNIT 3H
CHARLESTON UNIT 2H
JACKKNIFE UNIT 2H
N30°00'E
NOT TO SCALE
WV NORTH ZONE GRID NORTH
REFERENCES
WELL NO. 1H 47-085-10178
S 67°21' W 258.8'
S 56°37' E 263.4'
STAKE/NAIL, SET
STAKE/NAIL, SET
1" = 200'
GRID NORTH
FRANK TUMAS D.B. 270 PG. 565 T.M. 13 PAR. 04.2 226.87 AC.±
FRANK TUMAS D.B. 270 PG. 565 T.M. 8 PAR. 27.1 65 AC.±
W.J. COLLINS ET UX LEASE
NOTE: 4 WATER WELLS WERE LOCATED WITHIN 2000' OF THE CENTER OF PROPOSED PAD
4790
7337
6430
WELL NO. 1H 47-085-10178
3000'
S 37°11' E 1377.7'
S 16°09' W 1654.4'
S 00°53' W 1743.8'
S 05°39' W 1752.7'
7349
3415
165
359
N 21°02' W 9292.7'
THOMAS SUMMERS LICENSED No. 2109 STATE OF WEST VIRGINIA PROFESSIONAL SURVEYOR
TORIE L. KNIGHT ET AL D.B. 305 PG. 380 T.M. 14 PAR. 01 84.39 AC.±
MICHAEL H. YUDT ET AL D.B. 296 PG. 169 T.M. 14 PAR. 11.2 29.9 AC.±
1H BOTTOM HOLE
LEWIS P. DAVIS ET AL D.B. 232 PG. 215 T.M. 14 PAR. 03 72.337 AC.±
FRANCIS L. PRUNTY ET AL D.B. 190 PG. 327 T.M. 13 PAR. 10.2 0.538 AC.±
FRANCIS L. PRUNTY ET AL D.B. 218 PG. 56 T.M. 13 PAR. 10.6 0.768 AC.±
CURTIS M. BOWIE ET AL D.B. 290 PG. 810 T.M. 13 PAR. 10.9 0.762 AC.±
DRAIN O 1491
MICHAEL H. YUDT ET AL D.B. 296 PG. 169 T.M. 14 PAR. 11.1 67 AC.±
JAMES F. WILLIAMSON ET AL D.B. 262 PG. 314 T.M. 14 PAR. 01.2 6.91 AC.±
LEWIS P. DAVIS ET AL D.B. 275 PG. 27 T.M. 14 PAR. 10 12.49 AC.±
IRON PIPE, FOUND
FLOYD T. BUTCHER III D.B. 234 PG. 1 T.M. 14 PAR. 11.10 15 AC.±
IRON PIPE FOUND
STEPHEN D. JACKSON D.B. 307 PG. 590 T.M. 14 PAR. 09 53.511 AC.±
RUN
POPLARLICK
74
JEFFREY A. HURST ET AL D.B. 305 PG. 1081 T.M. 14 PAR. 11 16.97 AC.±
N 13°23' W 2413.3'
N 03°39' W 2708.3'
MARY MAXINE WELCH LEASE
STEVE JACKSON LEASE
BELL COOPER HEIRS D.B. 150 PG. 324 T.M. 14 PAR. 16 117 AC.±
LANDING POINT
N:300683
E:1590001
N 65°21' W 539.7'
WELL NO. 1H 47-085-10178
HARVEY WEIGLE HEIRS LEASE
STEPHEN C. JACKSON ET AL D.B. 236 PG. 742 T.M. 14 PAR. 22 40.835 AC.±
R. JONES ET AL D.B. 216 PG. 665 T.M. 14 PAR. 21 31 AC.±
NOTE
NO OCCUPIED DWELLINGS OR BUILDINGS TWO THOUSAND FIVE HUNDRED (2,500) SQUARE FEET OR LARGER USED TO HOUSE OR SHELTER DAIRY CATTLE OR POULTRY HUSBANDRY ARE LOCATED WITHIN SIX HUNDRED TWENTY-FIVE (625) FEET OF THE CENTER OF THE WELL PAD.
LEGEND
Surface Owner Boundary Lines +/-
Interior Surface Tracts +/-
Existing Fence
Found monument, as noted
THOMAS SUMMERS P.S. 2109
DATE 10/16/15
OPERATOR'S WELL# JACKKNIFE UNIT #1H
API WELL # 47 — 085 — 10178 MOD-HA
STATE COUNTY PERMIT
JOB # 14-008WA
DRAWING # JACKKNIFE1HR1
SCALE 1" = 1000'
MINIMUM DEGREE OF ACCURACY SUBMETER
PROVEN SOURCE OF ELEV. SUBMETER MAPPING GRADE GPS
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 RULES ISSUED AND PERSCRIBED BY THE DEPTARTMENT OF ENVIRONMENTAL PROTECTION.
STATE OF WEST VIRGINIA, DIVISION OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS
WILLOW LAND SURVEYING PLLC P.O. BOX 17 PENNSBORO WEST VIRGINIA 26415
STATE OF WEST VIRGINIA DEPARTMENT OF ENERGY DIVISION OF OIL AND GAS
WELL TYPE: OIL ___ GAS X LIQUID INJECTION ___ WASTE DISPOSAL ___
(IF "GAS") PRODUCTION X STORAGE ___ DEEP ___ SHALLOW X
LOCATION: ELEVATION 1,163' ORIGINAL - 1,127' AS BUILT WATERSHED NORTH FORK HUGHES RIVER
QUADRANGLE PENNSBORO 7.5' DISTRICT CLAY COUNTY RITCHIE
SURFACE OWNER STEPHEN C. JACKSON ET AL ACREAGE 40.835 ACRES +/-
OIL & GAS ROYALTY OWNER HARVEY WEIGLE HEIRS; STEVE JACKSON; LEASE ACREAGE 51 ACRES±; 117 ACRES±;
MARY MAXINE WELCH; CLIFF WILSON ET UX; W.J. COLLINS ET UX; MARY MAXINE WELCH; WILLIAM DAVIS HEWITT 163 ACRES±; 413 ACRES±; 575 ACRES±; 76.43 ACRES±; 20 ACRES±
PROPOSED WORK: DRILL X CONVERT ___ DRILL DEEPER ___ REDRILL ___ FRACTURE OR STIMULATE X PLUG OFF OLD FORMATION ___ PERFORATE NEW FORMATION X
OTHER PHYSICAL CHANGE IN WELL (SPECIFY) MOD-SHL
PLUG & ABANDON ___ CLEAN OUT & REPLUG ___ ESTIMATED DEPTH 6,500' TVD 16,300' MD
TARGET FORMATION MARCELLUS
WELL OPERATOR ANTERO RESOURCES CORP.
ADDRESS 1615 WYNKOOP STREET
DENVER, CO 80202
DESIGNATED AGENT DIANNA STAMPER
CT CORPORATION SYSTEM
ADDRESS 5400 D BIG TYLER ROAD
CHARLESTON, WV 25313
COUNTY NAME PERMIT
FORM WW-6