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west virginia department of environmental protection

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Office of Oil and Gas  
601 57<sup>th</sup> Street, S.E.  
Charleston, WV 25304  
(304) 926-0450  
fax: (304) 926-0452

Austin Caperton, Cabinet Secretary  
[www.dep.wv.gov](http://www.dep.wv.gov)

Tuesday, May 14, 2019  
PERMIT MODIFICATION APPROVAL  
Horizontal 6A / New Drill

ARSENAL RESOURCES LLC  
6031 WALLACE ROAD EXTENSION  
SUITE 603  
WEXFORD, PA 15090

Re: Permit Modification Approval for J OSBORN HSOP 16 203  
47-033-05941-00-00

Conductor casing depths and weight, intermediate casing depth, and production casing weight have changed.

ARSENAL RESOURCES LLC

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.

If there are any questions, please feel free to contact me at (304) 926- 0450.

James A. Martin  
Chief

A handwritten signature in blue ink, appearing to read 'James A. Martin', is written over the typed name and title.

Operator's Well Number: J OSBORN HSOP 16 203  
Farm Name: JUDY M OSBORN (LE) (JUDY M OSBORN IRREVOCABLE)  
U.S. WELL NUMBER: 47-033-05941-00-00  
Horizontal 6A New Drill  
Date Modification Issued: May 14, 2019

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

1) Well Operator: Arsenal Resources      494519412      Harrison      Simpson      Rosemont  
Operator ID      County      District      Quadrangle

2) Operator's Well Number: J Osborn HSOP 16 203      Well Pad Name: J Osborn HSOP 16

3) Farm Name/Surface Owner: Judy M. Osborn (LE)      Public Road Access: 77/4 Moss Run (Coplin Run)

4) Elevation, current ground: 1164.36'      Elevation, proposed post-construction: 1163.30'

5) Well Type    (a) Gas          Oil      \_\_\_\_\_      Underground Storage      \_\_\_\_\_

Other      \_\_\_\_\_

(b) If Gas    Shallow          Deep      \_\_\_\_\_

Horizontal          \_\_\_\_\_

*SDW*  
*5/9/2019*

6) Existing Pad: Yes or No No

7) Proposed Target Formation(s), Depth(s), Anticipated Thickness and Expected Pressure(s):  
Target Formation- Marcellus Shale, Top- 7020.3 ft, Bottom- 7120.3 ft, Anticipated Thickness- 100 ft, Associated Pressure- 0.5 psi/ft

8) Proposed Total Vertical Depth: 7,108.3 ft

9) Formation at Total Vertical Depth: Marcellus Shale

10) Proposed Total Measured Depth: 24,486.47 ft

11) Proposed Horizontal Leg Length: 16,918.44 ft

12) Approximate Fresh Water Strata Depths: 43 ft, 258 ft, 356 ft, 539 ft, 725 ft

13) Method to Determine Fresh Water Depths: offsetting wells reported water depths (033-02179, 033-02507, 033-02975)

14) Approximate Saltwater Depths: None Expected

15) Approximate Coal Seam Depths: Harlem - 146', Bakerstown - 227', Brush Creek - 320', Upper Freeport - 399', Lower Freeport - 437', Upper Kittanning - 527', Middle Kittanning - 590', Lower Kittanning - 611'

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

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

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

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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	24	Used		94	100	100	CTS
Fresh Water	13.375	New	J-55	54.5	800	800	CTS
Coal							
Intermediate	9.625	New	J-55	40	2500	2500	CTS
Production	5.5	New	P-110	20	24,486	24,486	TOC @ 2,350
Tubing							
Liners							

*SDw  
5/9/2019*

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	24	36			0	Class A, 3% CaCl2	1.2
Fresh Water	13.375	17.5	0.38	2,730	900	Class A, 3% CaCl2	1.2
Coal							
Intermediate	9.625	12.25	0.395	3,950	1,500	Class A, 3% CaCl2	1.29
Production	5.5	8.5-8.75	0.361	15,920	9,500	Class A/50:50 Poz	1.29/1.34
Tubing					5,000		
Liners					N/A		

**PACKERS**

Kind:				
Sizes:				
Depths Set:				

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

The well will be started with a conductor rig drilling a 36" hole to Conductor programmed depth then running 24" casing and circulate cement back to surface. The conductor rig will move out and the drilling rig will move in and rig up. The drilling rig will then spud a 17 1/2" hole and drill to fresh water casing (Surface) to the programmed depth, Run 13- 3/8" casing and cement to surface. The rig will continue drilling a 12- 1/4" intermediate hole to the programmed depth, run 9- 5/8" casing and cement to surface. The rig will then continue to drill an 8- 3/4" hole to a designed pilot hole depth, then trip out of hole to run wireline logs. A cement kick-off plug will then be set from bottom of the pilot hole to the designed KOP. We will then drill off the cement plug and start drilling the curve and lateral section to the programmed total measured depth, run 5 1/2" casing and cement according to the program

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

The well will be completed using a plug and perforation method and stimulated with a slickwater and sand slurry. The anticipated maximum rate will be 90 bpm and the maximum pressure will be 9,500 psi.

21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 17.26

22) Area to be disturbed for well pad only, less access road (acres): 6.63

23) Describe centralizer placement for each casing string:

24"- No centralizers 13 3/8" – one bow spring centralizer on every other joint 9 5/8" – one bow spring centralizer every third joint from TD to surface 5 1/2" – one semi rigid centralizer on every joint from TD of casing to end of curve. Then every other joint to KOP. Every third joint from KOP to 2,600'; there will be no centralizers from 2,600 to surface.

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

24" will be circulated to surface. The 13 3/8" casing will be cemented to surface with Class A cement and no greater than 3% CaCl (calcium chloride). The 9 5/8" casing will be cemented to surface with Class A cement, & no greater than 3% calcium chloride. The 5 1/2" production string will be cemented back to 2,350' (+/- 150' above the casing shoe for the 9 5/8") with Class A and 50/50 Poz cement retarded (to extend pumpability) cellophane flaked for fluid loss, Bentonite gel as an extender (increased pumpability and fluid loss), a defoaming agent to decrease cement foaming during mixing to insure the cement is of proper weight to placement and possibly gypsum gas blocking additive to aid in blocking/gas migration (in combination with other additive mentioned here, helps cement achieve a "right angle" set) during the plastic phase of the cement set-up.

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25) Proposed borehole conditioning procedures:

Top holes will be drilled with fresh water KOP. At KOP, the wellbore will be loaded with synthetic oil based mud barite-weighted mud system with such properties as to build a filter-cake on the face of the bore-hole. This will provide lubricity as well as stabilizing the well bore. We will begin rotating the drill string and mud will be circulated upon reaching TD until no further cuttings are observed coming across the shaker screens. Once clean mud is circulated back to surface, we will pull three stands of drill pipe, load the hole, pull three strands and load the hole. The weight indicator on the rig will be monitored for any occurrences of drag and if any are noticed, we will re-run the previous stand of pipe pulled across and circulate 2x bottoms up while watching shakers for signs of cuttings. Once at the base curve, the string will be continuously rotated while pumping 2x bottoms up. We will pull three stands and fill the hole until we reach the vertical section of the well.

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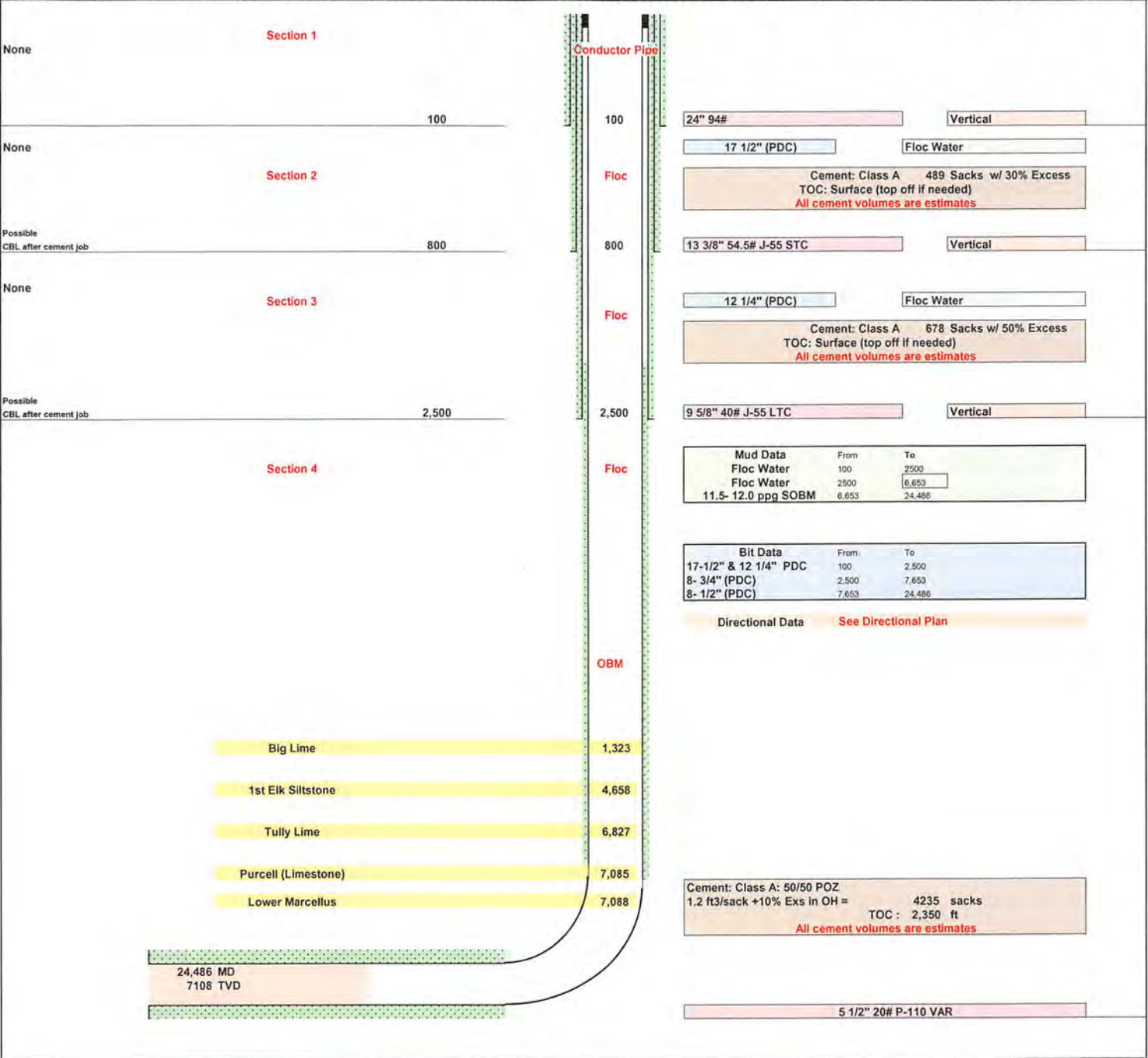
\*Note: Attach additional sheets as needed.



Other Names:	N/A
Surface Location:	TBD
Bottom Hole Location:	TBD
Total Depth:	24,486 MD (ft) 7,108 TVD (ft)

County:	Harrison
State:	West Virginia
AFE #:	XX
RKB:	27
Ground Level:	1,163

Logs	Significant Formations (TVD)	Depth (ft) MD	Depth (ft) TVD	Hole Size	Casing and Cement	Mud	Directional & Surveys
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Revision 1  
 Note: Not drawn to scale  
 Date Last Revised: 7-May-19  
 Jarrett Toms  
 RECEIVED  
 WV Department of Environmental Protection  
 Cement Outside Casing  
 Seal Assembly in Annulus  
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