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**west virginia** department of environmental protection

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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

March 10, 2015

**WELL WORK PERMIT**

**Horizontal 6A Well**

This permit, API Well Number: 47-5101760, issued to GASTAR EXPLORATION INC., is evidence of permission granted to perform the specified well work at the location described on the attached pages and located on the attached plat, subject to the provisions of Chapter 22 of the West Virginia Code of 1931, as amended, and all rules and regulations promulgated thereunder, and to all conditions and provisions outlined in the pages attached hereto.

Notification shall be given by the operator to the Oil and Gas Inspector at least 24 hours prior to the construction of roads, locations, and/or pits for any permitted work. In addition, the well operator shall notify the same inspector 24 hours before any actual well work is commenced and prior to running and cementing casing. Spills or emergency discharges must be promptly reported by the operator to 1-800-642-3074 and to the Oil and Gas inspector.

Please be advised that form WR-35, Well Operators Report of Well Work is to be submitted to this office within 90 days completion of permitted well work, as should form WR-34 Discharge Monitoring Report within 30 days of discharge of pits, if applicable. Failure to abide by all statutory and regulatory provisions governing all duties and operations hereunder may result in suspension or revocation of this permit and, in addition, may result in civil and/or criminal penalties being imposed upon the operators.

In addition to the applicable requirements of this permit, and the statutes and rules governing oil and gas activity in WV, this permit may contain specific conditions which must be followed. Permit conditions are attached to this cover letter.

Per 35CSR-4-5.2.g this permit will expire in two (2) years from the issue date unless permitted well work is commenced. If there are any questions, please feel free to contact me at (304) 926-0499 ext. 1654.

James Martin  
Chief

Operator's Well No: BOWMAN 2H  
Farm Name: BOWMAN, THOMAS AND VICTC  
**API Well Number: 47-5101760**  
**Permit Type: Horizontal 6A Well**  
Date Issued: 03/10/2015

**Promoting a healthy environment.**

**03/13/2015**

# PERMIT CONDITIONS

West Virginia Code § 22-6A-8(d) allows the Office of Oil and Gas to place specific conditions upon this permit. Permit conditions have the same effect as law. Failure to adhere to the specified permit conditions may result in enforcement action.

## CONDITIONS

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1. Gastar shall not conduct any fracturing operations in such a manner as to adversely impact Eagle Natrium, LLC's brine field operation.
2. Gastar shall coordinate with Eagle Natrium, LLC to ensure that they are sharing information with regard to monitoring of both Eagle Natrium, LLC's brine field wells and Gastar's natural gas well during the fracturing process of the natural gas well that is the subject of the instant permit.
3. Gastar shall immediately terminate fracturing operations and initiate emergency flowback procedures to immediately relieve any pressure, fluid, or gas influences on the brine field, should Gastar or Eagle Natrium, LLC observe any communications with Eagle Natrium, LLC's brine field, including the brine field wells. Gastar shall notify the Office of Oil and Gas immediately of any potential or actual communications between Gastar's natural gas well and Eagle Natrium, LLC's brine field, including the brine field wells.
4. As a means of identification of a possible geologic feature such as a fault or fracture that could create a communications conduit, prior to initiating any fracturing operations, Gastar shall establish a minimum pressure threshold. Gastar shall shut down operations immediately should the pressure go below the set threshold (i.e. if Gastar experiences a "soft frac"). In that event, Gastar shall immediately notify the Office of Oil and Gas and initiate emergency flow-back procedures.
5. Gastar shall provide to OOG a report detailing the fracturing treatment within 90 days of such operations.
6. Gastar shall notify the OOG inspector and Eagle Natrium, LLC of the date on which fracturing operations will be initiated. Such notice shall be at least 24 hours in advance of initiation of fracturing operations.
7. This proposed activity may require permit coverage from the United States Army Corps of Engineers (USACE). Through this permit, you are hereby being advised to consult with USACE regarding this proposed activity.
8. If the operator encounters an unanticipated void, or an anticipated void at an unanticipated depth, the operator shall notify the inspector within 24 hours. Modifications to the casing program may be necessary to comply with W. Va. Code § 22-6A-5a (12), which requires drilling to a minimum depth of thirty feet below the bottom of the void, and installing a minimum of twenty (20) feet of casing. Under no circumstance should the operator drill more than fifty (50) feet below the bottom of the void or install less than twenty (20) feet of casing below the bottom of the void.
9. When compacting fills, each lift before compaction shall not be more than 12 inches in height, and the moisture content of the fill material shall be within limits as determined by the Standard Proctor Density test of the actual soils used in specific engineered fill, ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort, to achieve 95 % compaction of the optimum density. Each lift shall be tested for compaction, with a minimum of two tests per lift per acre of fill. All test results shall be maintained on site and available for review.
10. Operator shall install signage per § 22-6A-8g (6) (B) at all source water locations included in their approved water management plan within 24 hours of water management plan activation.

## PERMIT CONDITIONS

11. Oil and gas water supply wells will be registered with the Office of Oil and Gas and all such wells will be constructed and plugged in accordance with the standards of the Bureau for Public Health set forth in its Legislative rule entitled *Water Well Regulations*, 64 C.S.R. 19. Operator is to contact the Bureau of Public Health regarding permit requirements. In lieu of plugging, the operator may transfer the well to the surface owner upon agreement of the parties. All drinking water wells within fifteen hundred feet of the water supply well shall be flow tested by the operator upon request of the drinking well owner prior to operating the water supply well.
12. Pursuant to the requirements pertaining to the sampling of domestic water supply wells/springs the operator shall, no later than thirty (30) days after receipt of analytical data provide a written copy to the Chief and any of the users who may have requested such analyses.
13. If any explosion or other accident causing loss of life or serious personal injury occurs in or about a well or well work on a well, the well operator or its contractor shall give notice, stating the particulars of the explosion or accident, to the oil and gas inspector and the Chief, within 24 hours of said accident.
14. During the casing and cementing process, in the event cement does not return to the surface, the oil and gas inspector shall be notified within 24 hours.
15. Operator shall provide the Office of Oil & Gas notification of the date that drilling commenced on this well. Such notice shall be provided by sending an email to [DEPOOGNotify@wv.gov](mailto:DEPOOGNotify@wv.gov) within 30 days of commencement of drilling.

WW-6B  
(9/13)

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

51 3 558

1) Well Operator: Gastar Exploration Inc. 494487685 Marshall Franklin Powhatan Point 7.5'  
Operator ID County District Quadrangle

2) Operator's Well Number: 2H Well Pad Name: Bowman

3) Farm Name/Surface Owner: Thomas & Victoria Bowman Public Road Access: Waynes Ridge County Route 78

4) Elevation, current ground: 1230' Elevation, proposed post-construction: 1223'

5) Well Type (a) Gas  Oil  Underground Storage

Other

(b) If Gas Shallow  Deep

Horizontal

see 4/16/2014

6) Existing Pad: Yes or No No

7) Proposed Target Formation(s), Depth(s), Anticipated Thickness and Associated Pressure(s):  
The Marcellus is the target formation at a depth of 6283', thickness of 46' and an anticipated pressure of approx. 3200 psi.

8) Proposed Total Vertical Depth: 6429'

9) Formation at Total Vertical Depth: Onondaga

10) Proposed Total Measured Depth: 10,344'

11) Proposed Horizontal Leg Length: 3,500'

12) Approximate Fresh Water Strata Depths: Shallowest at 70' and deepest at 1170'

13) Method to Determine Fresh Water Depths: Noticeable flow at the flowline or when needed to start soaping

14) Approximate Saltwater Depths: 1740'

15) Approximate Coal Seam Depths: Sewickley Coal - 815' & Pittsburg Coal - 1160'

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

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

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(9/13)

18)

CASING AND TUBING PROGRAM

<u>TYPE</u>	<u>Size</u>	<u>New or Used</u>	<u>Grade</u>	<u>Weight per ft. (lb/ft)</u>	<u>FOOTAGE: For Drilling</u>	<u>INTERVALS: Left in Well</u>	<u>CEMENT: Fill-up (Cu. Ft.)</u>
Conductor	20"	New	PE	54.5 #/ft		120'	183 ft <sup>3</sup> (CTS)
Fresh Water	13 3/8"	New	H-40	48 #/ft		1250'	870 ft <sup>3</sup> (CTS)
Coal	13 3/8"	New	H-40	48 #/ft		1250'	870 ft <sup>3</sup> (CTS)
Intermediate	9 5/8"	New	J-55	36 #/ft		2700'	845 ft <sup>3</sup> (CTS)
Production	5 1/2"	New	P-110	20 #/ft		10,344'	2745 ft <sup>3</sup> (CTS)
Tubing	2 3/8"	New	N-80	4.7 #/ft		6,260'	
Liners							

JW 4/16/14

<u>TYPE</u>	<u>Size</u>	<u>Wellbore Diameter</u>	<u>Wall Thickness</u>	<u>Burst Pressure</u>	<u>Cement Type</u>	<u>Cement Yield (cu. ft./k)</u>
Conductor	20"	26"	.25"	880 psi	Class A	1.2 cuft/sack
Fresh Water	13 3/8"	17"	.33"	1730 psi	See # 22	1.2 cuft/sack
Coal	13 3/8"	17"	.33"	1730 psi	See # 22	1.2 cuft/sack
Intermediate	9 5/8"	12 1/4"	.352	3520	See # 22	1.2 cuft/sack
Production	5 1/2"	8 7/8" & 8 3/4"	.361	12,640 psi	See # 22	1.18 cuft/sack
Tubing	2 3/8"		.19	11,200 psi		
Liners						

PACKERS

Kind:	n/a			
Sizes:	n/a			
Depths Set:	n/a			

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

Drill through the Marcellus tagging less than one hundred (100') feet from the top of the Onondaga to get depths and log data. Then plug the well back to proposed kick off point (TBD). Drill the horizontal section to planned and proposed TD. Run casing and cement back to surface. Run a bond log from approximately 60 degrees back to surface, pressure test casing and set a master valve. Make a clean out run on the casing and perforate then stimulate.

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

Gastar Exploration plans to fracture the well using a typical slickwater fracture design. Gastar will pump roughly 8000 bbls of water and 325,000 lbs of sand per stage. There will be approximately 18 stages.

21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 20.20 acres

22) Area to be disturbed for well pad only, less access road (acres): 4.54 acres

## 23) Describe centralizer placement for each casing string:

Gastar will run 3 centralizers on the surface casing at an equal distance. The intermediate casing will have 7 centralizers at 300' spacing. The production casing will have one centralizer every other joint in the lateral, one centralizer per joint through the curve and one centralizer every other joint in the vertical section.

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

✓ Class A + 2% CaCl<sub>2</sub> + 1/4# Flake - Surface Cement mixed at 15.6 ppg. CaCl<sub>2</sub> (calcium chloride), Flake (cellophane flake)  
Class A + 1% CaCl<sub>2</sub> + 1/4# Flake - Intermediate Cement mixed at 15.6 ppg. 50:50 Class H .2%CD32 1.2%FL62 .1%  
ASA301 .4%SMS - Long String Lead mixed 14.5 ppg. CD32 (cement dispersant), FL 62 (fluid loss), SMS (sodium metasilicate), ASA (minimizes free fluid). 50:50 TYPE 1 .4% R3 1%FL62 .15%ASA301 .3%CD32-Long String Tail-14.5ppg

## 25) Proposed borehole conditioning procedures:

Gastar will circulate the hole a minimum of 3 hours upon TD. We will then pull out to the bottom of the curve and circulate for another 2 hours. Then come out of the hole.

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\*Note: Attach additional sheets as needed.

51-01760

4705101760

Bowman 2H  
Marshall County, WV

20" 54.9# PE @ 120'

3 Centralizers @ Even Spacing

13 3/8" 48# H-40 ST&C  
Set @ 1250' MD

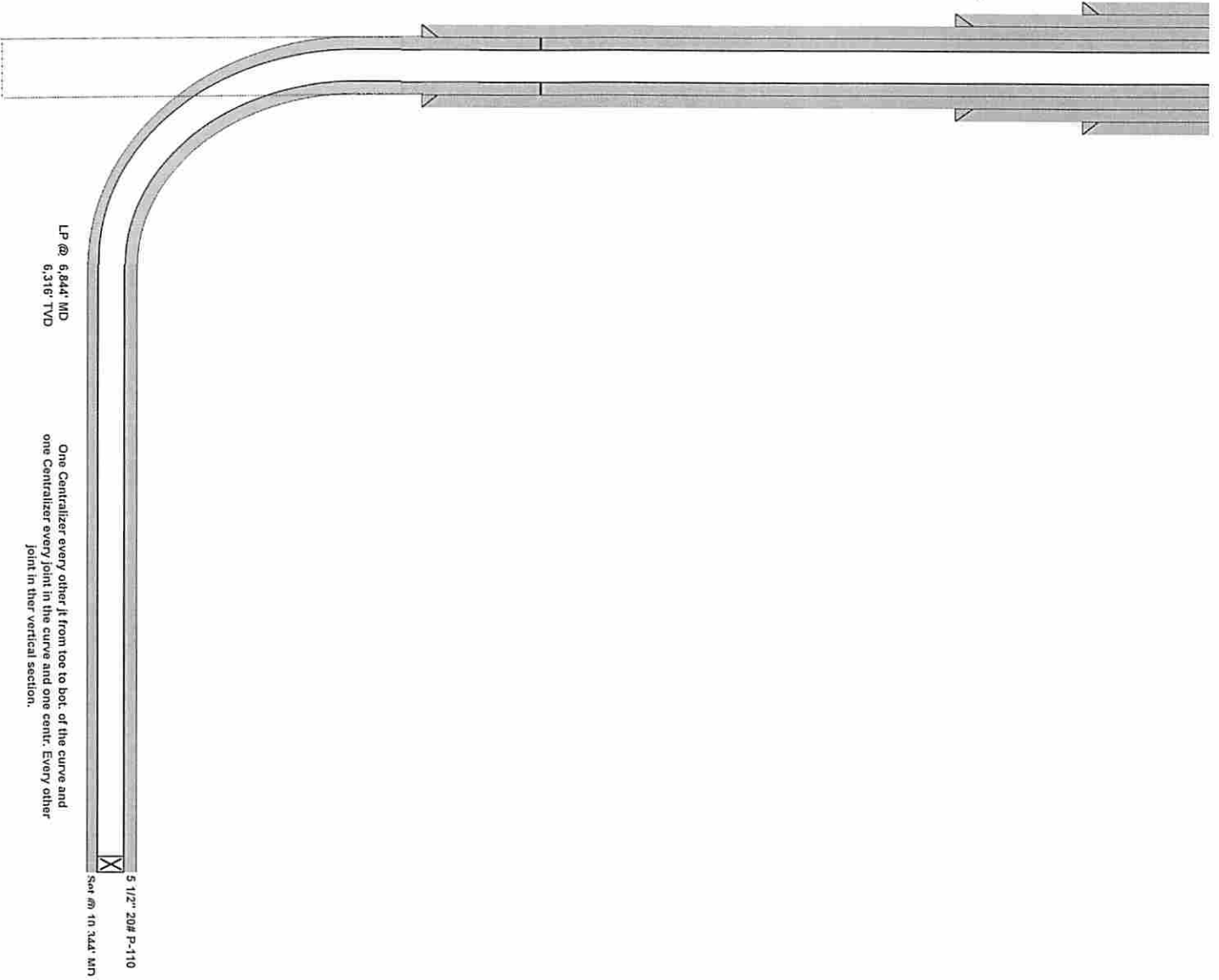
Wellbore 12.25"

7 Centralizers @ 300' Spacing

9 5/8" 36# J-55  
Set @ 2,700' MD

8 7/8" wellbore

Pilot Hole  
TD Pilot Hole @ 6,429' TVD



LP @ 6,844' MD  
6,316' TVD

One Centralizer every other ft from toe to bot. of the curve and  
one Centralizer every joint in the curve and one centr. Every other  
joint in their vertical section.

5 1/2" 20# P-110  
Set @ 10,344' MD

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03/13/2015

51-01760



# GASTAR EXPLORATION USA, INC.

Location: Marshall County, WV  
 Field: Marshall  
 Facility: Bowman Pad

Wellbore: Bowman 2H (PWB)

Slot: Slot #2  
 Well: Bowman 2H  
 Wellbore: Bowman 2H (PWB)

## Well Profile Data

Location Information			
Facility Name	Grid East (US ft)	Grid North (US ft)	Latitude
Bowman Pad	1685038.490	14442972.750	39.4611, 509°N
Local N (ft)	Grid East (US ft)	Grid North (US ft)	Latitude
19.82	1685038.180	14442992.560	39.4611, 705°N
Slot #2	2.89	14442992.560	80°50'28.313"W
NH 777 (RT) to Mud line (A1 Slot, Slot #2)			
Mean Sea Level to Mud line (A1 Slot, Slot #2)	101'		
NH 777 (RT) to Mean Sea Level			
1233ft			

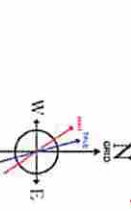
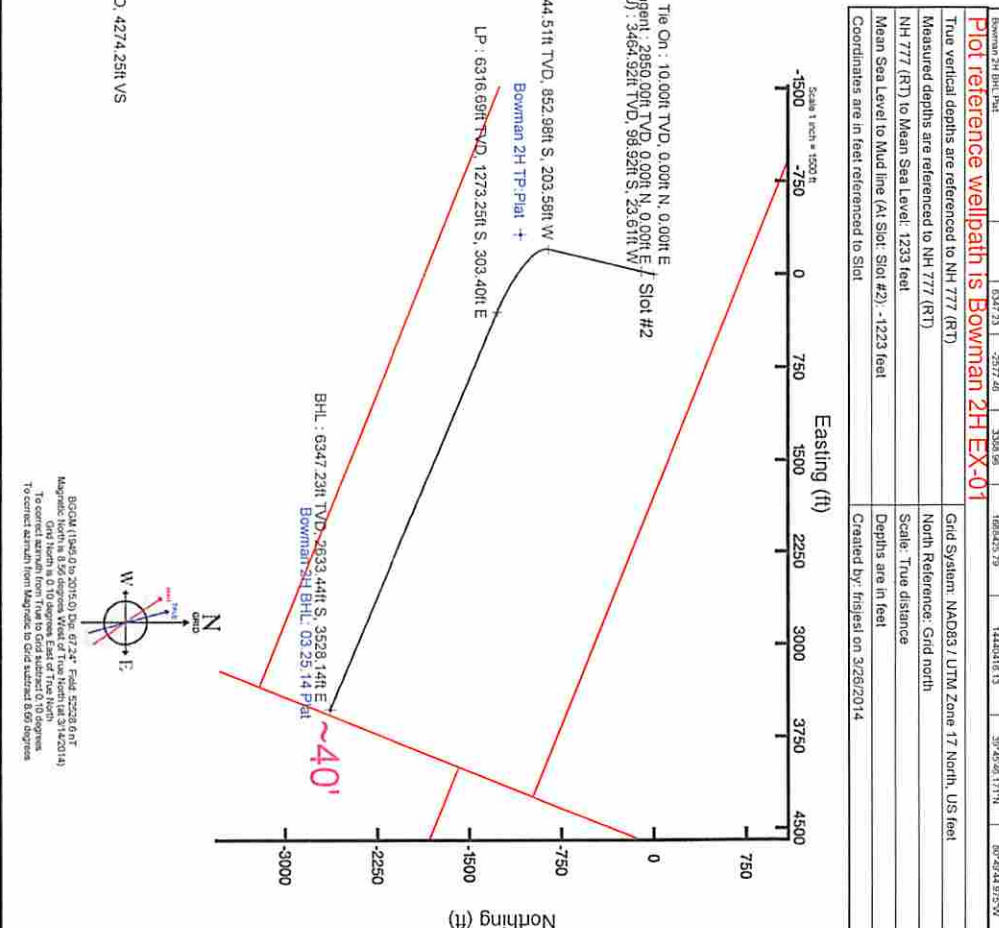
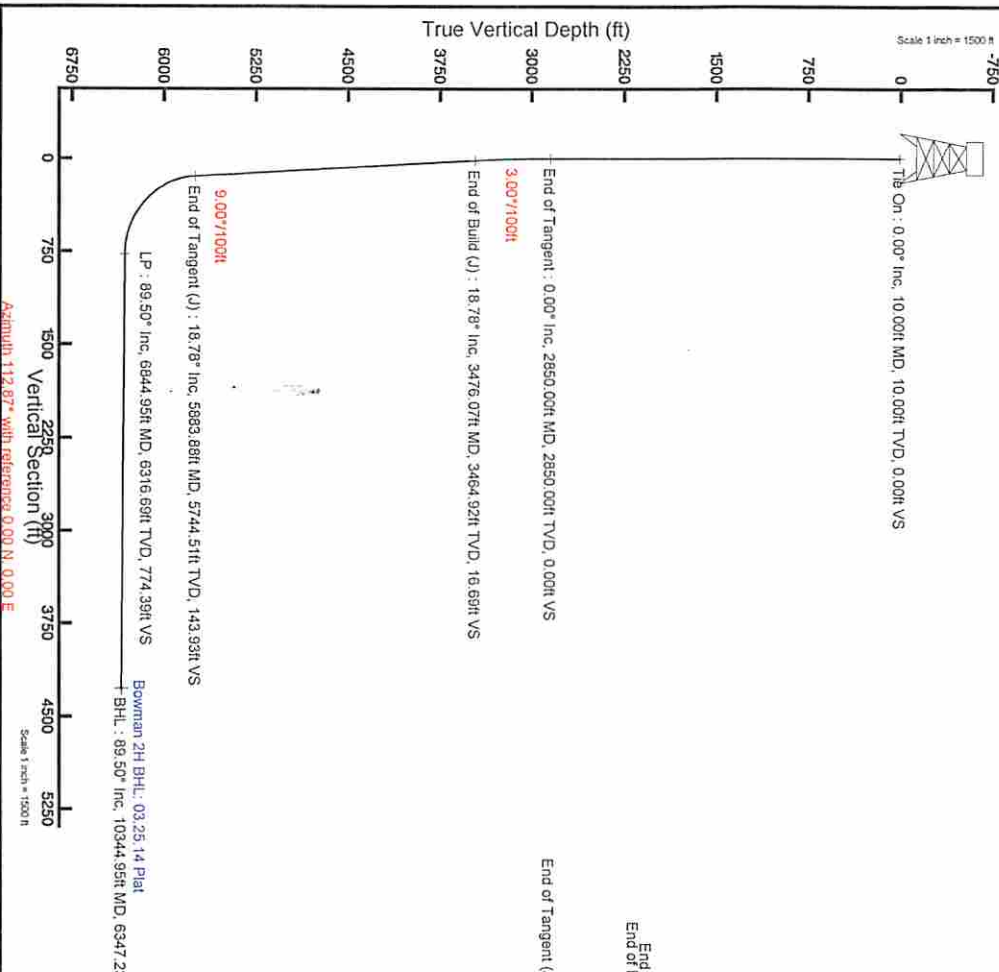
Design Comment	MD (ft)	Inc (")	Ac (")	TVD (ft)	Local N (ft)	Local E (ft)	DLS (7/100ft)	VS (ft)
Tie On	10.00	0.000	193.424	10.00	0.00	0.00	0.00	0.00
End of Tangent	2850.00	0.000	193.424	2850.00	0.00	0.00	0.00	0.00
End of Build (J)	3476.07	18.782	193.424	3464.92	-68.92	-238.61	3.00	16.69
End of Tangent (J)	5883.88	18.782	193.424	5744.51	-852.98	-208.58	0.00	143.93
LP	6544.95	89.500	112.870	6316.69	-1273.25	303.40	9.00	774.39
BHL	10344.95	89.500	112.870	6347.23	-2633.44	3528.14	0.00	4274.25

## Targets

Name	MD (ft)	TVD (ft)	Local N (ft)	Local E (ft)	Grid East (US ft)	Grid North (US ft)	Latitude	Longitude
Bowman 2H TP:Plat	6316.69	10344.95	-1044.71	-322.23	1684715.98	14441092.28	39°46'02.91"N	80°50'28.46"W
Bowman 2H BHL: 03.25 14 Plat	10344.95	10344.95	-2633.44	3528.14	1686584.91	14442992.17	39°45'51.15"N	80°49'43.18"W
Bowman 2H BHL: Plat	6347.23	6347.23	-2677.06	3388.96	1686435.79	14442918.13	39°45'45.17"N	80°49'44.82"W

Plot reference wellpath is Bowman 2H EX-01

True vertical depths are referenced to NH 777 (RT)		Grid System: NAD83 / UTM Zone 17 North, US feet	
Measured depths are referenced to NH 777 (RT)		North Reference: Grid north	
NH 777 (RT) to Mean Sea Level: 1233 feet		Scale: True distance	
Mean Sea Level to Mud line (A1 Slot, Slot #2): -1223 feet		Depths are in feet	
Coordinates are in feet, referenced to Slot		Created by: frispel on 3/28/2014	



BGM14 (1984) on 2015.03.09: 87.24° Field Azimuth 8.96°  
 Magnetic North is 8.96 degrees West of True North (at 3/20/14)  
 Grid North is 0.10 degrees East of True North  
 To correct azimuth from Magnetic to Grid, subtract 8.86 degrees

03/13/2015



WW-9  
(9/13)

API Number 47 - 051 - 01960  
Operator's Well No. 2H

4705101760

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

FLUIDS/ CUTTINGS DISPOSAL & RECLAMATION PLAN

Operator Name Gastar Exploration Inc. OP Code 494487685

Watershed (HUC 10) French Creek - Ohio River (undefined) Quadrangle Powhatan Point 7.5'

Elevation 1,223 County Marshall District Franklin

Do you anticipate using more than 5,000 bbls of water to complete the proposed well work? Yes  No

Will a pit be used? Yes  No

If so, please describe anticipated pit waste: Fresh water for frac and flow back water

Will a synthetic liner be used in the pit? Yes  No  If so, what ml.? \_\_\_\_\_

Proposed Disposal Method For Treated Pit Wastes:

- Land Application
- Underground Injection ( UIC Permit Number UIC 359; UIC 2D0732540; UIC 2D0732523 )
- Reuse (at API Number \_\_\_\_\_)
- Off Site Disposal (Supply form WW-9 for disposal location)
- Other (Explain \_\_\_\_\_)

Will closed loop system be used? If so, describe: Yes - For Vertical and Horizontal Drilling

Drilling medium anticipated for this well (vertical and horizontal)? Air, freshwater, oil based, etc. Air for vertical / Oil for Horizontal

-If oil based, what type? Synthetic, petroleum, etc. Synthetic Oil Base

Additives to be used in drilling medium? Barite for weight

Drill cuttings disposal method? Leave in pit, landfill, removed offsite, etc. All Drill Cuttings to be disposed of in Wetzel County Sanitary Landfill

-If left in pit and plan to solidify what medium will be used? (cement, lime, sawdust) \_\_\_\_\_

-Landfill or offsite name/permit number? Wetzel County Sanitary Landfill (SWF-1021 / WV 0109185)

I certify that I understand and agree to the terms and conditions of the GENERAL WATER POLLUTION PERMIT issued on August 1, 2005, by the Office of Oil and Gas of the West Virginia Department of Environmental Protection. I understand that the provisions of the permit are enforceable by law. Violations of any term or condition of the general permit and/or other applicable law or regulation can lead to enforcement action.

I certify under penalty of law that I have personally examined and am familiar with the information submitted on this application form and all attachments thereto and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment.

Company Official Signature Michael McCown

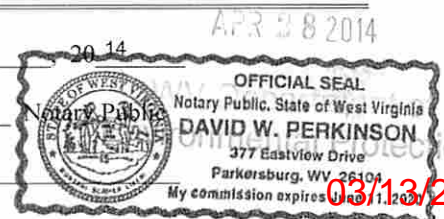
Company Official (Typed Name) Michael McCown

Company Official Title Senior VP & COO

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Subscribed and sworn before me this 11th day of April  
David W. Perkins

My commission expires 06/11/2020



03/13/2015

Form WW-9

Operator's Well No. 2H

Gastar Exploration Inc.

Proposed Revegetation Treatment: Acres Disturbed 20.20 Prevegetation pH \_\_\_\_\_

Lime 3 Tons/acre or to correct to pH 6.5

Fertilizer type 10-20-20

Fertilizer amount 1/3 ton lbs/acre

Mulch 2.5 Tons/acre

Seed Mixtures

**Temporary**

**Permanent**

Seed Type	lbs/acre
Annual Ryegrass	40

Seed Type	lbs/acre
Fox Tail / Grassy	40
Perennial Rye	30
Crown Vetch	20

Attach:

Drawing(s) of road, location, pit and proposed area for land application (unless engineered plans including this info have been provided)

Photocopied section of involved 7.5' topographic sheet.

Plan Approved by: James Nicholson James Unholzer

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Title: Oil & Gas Inspector

Date: 4/16/2014  
James Unholzer  
APR 28 2014

Field Reviewed? (  ) Yes (  ) No

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WV Department of Environmental Protection



# PROPOSED BOWMAN WELL NO. 2H

4705101760

TM 13 - PAR. 42  
THOMAS & VICTORIA BOWMAN  
45 ACRES

TM 13 - PAR. 35  
DAVID MAST  
24.90 ACRES

TM 13 - PAR. 39  
THOMAS & VICTORIA BOWMAN  
46 ACRES

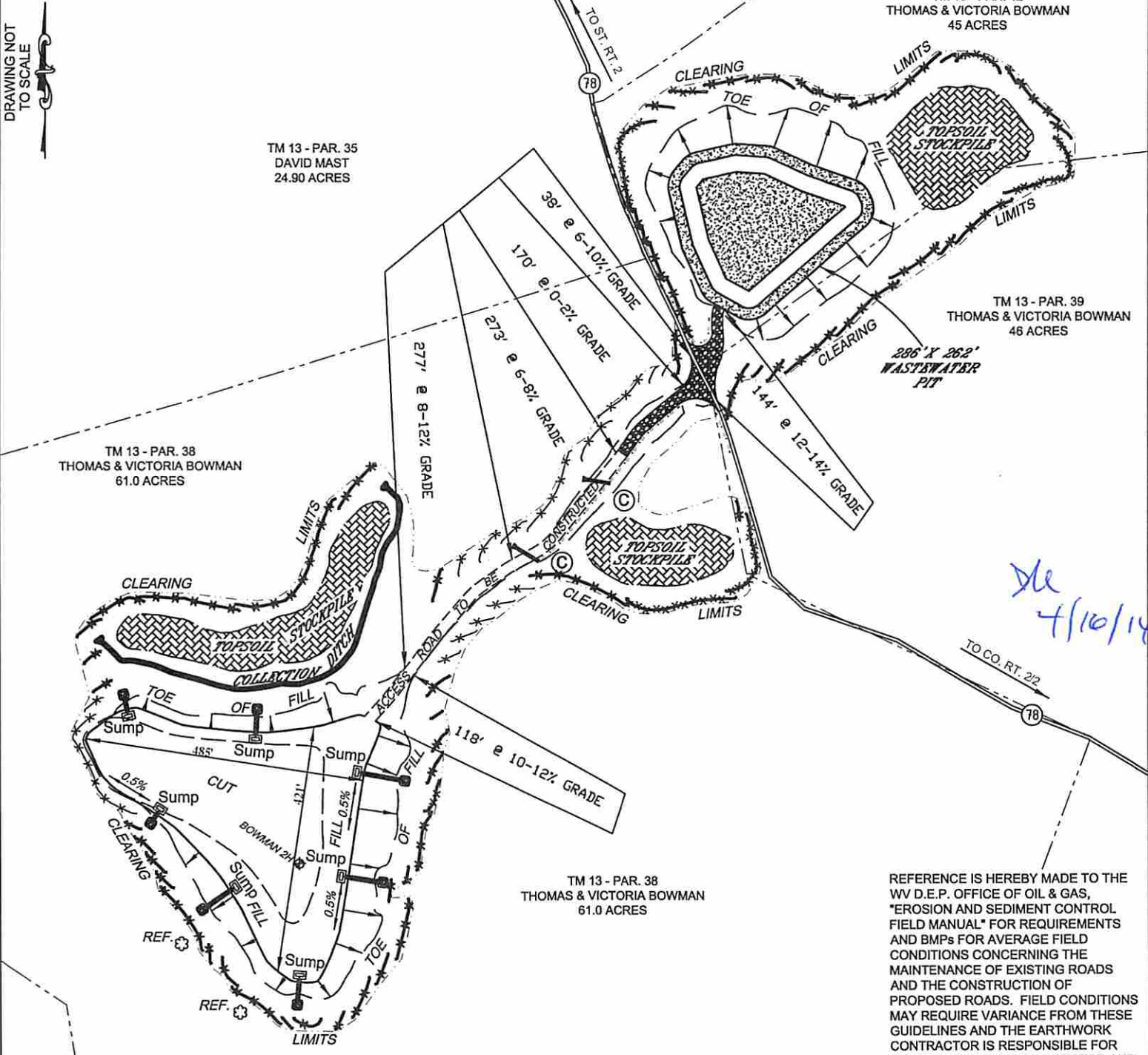
TM 13 - PAR. 38  
THOMAS & VICTORIA BOWMAN  
61.0 ACRES

TM 13 - PAR. 38  
THOMAS & VICTORIA BOWMAN  
61.0 ACRES

TM 13 - PAR. 37  
PPG INDUSTRIES, INC.  
51.21 ACRES

TM 20 - PAR. 24  
ROBERT RINE  
24.30 ACRES

DRAWING NOT TO SCALE



*de*  
*7/10/14*

REFERENCE IS HEREBY MADE TO THE WV D.E.P. OFFICE OF OIL & GAS, "EROSION AND SEDIMENT CONTROL FIELD MANUAL" FOR REQUIREMENTS AND BMPs FOR AVERAGE FIELD CONDITIONS CONCERNING THE MAINTENANCE OF EXISTING ROADS AND THE CONSTRUCTION OF PROPOSED ROADS. FIELD CONDITIONS MAY REQUIRE VARIANCE FROM THESE GUIDELINES AND THE EARTHWORK CONTRACTOR IS RESPONSIBLE FOR NOTIFICATION TO THE INSPECTOR AND THE OPERATOR SHOULD THESE CONDITIONS OCCUR.

INSTALL CULVERTS AS SHOWN ON RECLAMATION PLAN OR AS FIELD CONDITIONS REQUIRE.

ENTRANCES ONTO PUBLIC ROADS SHALL BE CONSTRUCTED OR MAINTAINED IN ACCORDANCE WITH WV D.O.T. REGULATIONS. ADDITIONAL PERMITS MAY BE REQUIRED.

APR 28 2014

Note:  
 (C) - Denotes install 18" PVC culvert and apply appropriate sediment outlet control (Rip Rap splash pad).

\*\*\* Silt Fence and/or Sediment and Erosion Control Measure.

TEMPORARILY SEED AND MULCH ALL SLOPES UPON CONSTRUCTION OF LOCATION.

ALL CUT AND FILL SLOPES ARE 2H : 1V SLOPE.

ALL TREES 6-INCHES AND ABOVE ARE TO BE CUT AND STACKED. BRUSH SLASHINGS ARE TO UTILIZED DOWN SLOPE OF SITE AND STRUCTURES TO ACT AS A CONTROL BARRIER IF AVAILABLE.

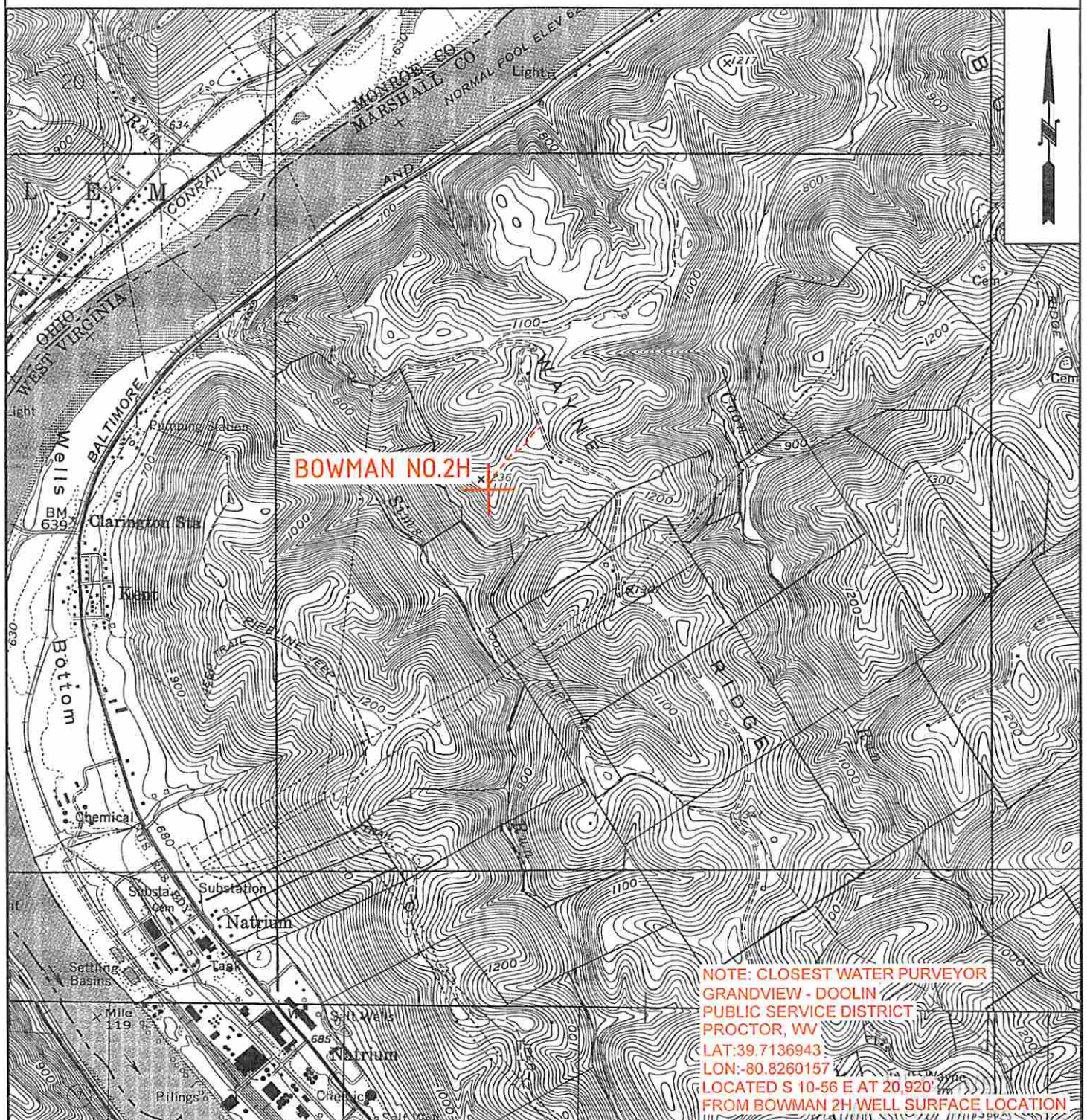


SI-01760  
4705101760

WW-9

# PROPOSED BOWMAN WELL No. 2H

SUPPLEMENT PG 2



**NOTE: CLOSEST WATER PURVEYOR**  
**GRANDVIEW - DOOLIN**  
**PUBLIC SERVICE DISTRICT**  
**PROCTOR, WV**  
**LAT: 39.7136943**  
**Lon: -80.8260157**  
**LOCATED S 10-56 E AT 20,920'**  
**FROM BOWMAN 2H WELL SURFACE LOCATION**

*See 4/16/14*

**W0120321**

**OPERATOR**  
 GASTAR EXPLORATION INC.  
 229 W Main Street, Suite 301  
 Clarksburg, WV 26301

**TOPO SECTION**  
 POWHATAN POINT 7.5'  
**SCALE:**  
 1"=2000'

**LEASE NAME**  
 APR 28 2014  
 BOWMAN  
**DATE:**  
 DATE: 03/23/14

**03/13/2015**



