

UIC - I - ____8 - 4__

**GENERAL
CORRESPONDENCE
(WDW-4)**

2017 - Present

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD
Sent: Wednesday, April 17, 2019 8:37 AM
To: 'Dade, Lewis (Randy)'; Denton, Scott
Subject: RE: Pressure Fall Off Tests of Navajo's UIC Program

Randy, et al.:

Approved.

Thank you.

Mr. Carl J. Chavez, CHMM (#13099)
New Mexico Oil Conservation Division
Energy Minerals and Natural Resources Department
1220 South St Francis Drive
Santa Fe, New Mexico 87505
Ph. (505) 476-3490
E-mail: CarlJ.Chavez@state.nm.us

“Why not prevent pollution, minimize waste to reduce operating costs, reuse or recycle, and move forward with the rest of the Nation?” (To see how, go to: <http://www.emnrd.state.nm.us/OCD> and see “Publications”)

From: Dade, Lewis (Randy) <Lewis.Dade@HollyFrontier.com>
Sent: Wednesday, April 17, 2019 7:28 AM
To: Chavez, Carl J, EMNRD <CarlJ.Chavez@state.nm.us>; Griswold, Jim, EMNRD <Jim.Griswold@state.nm.us>; Denton, Scott <Scott.Denton@HollyFrontier.com>
Cc: Dade, Lewis (Randy) <Lewis.Dade@HollyFrontier.com>
Subject: [EXT] Pressure Fall Off Tests of Navajo's UIC Program

Carl,
Please find attached Navajo's request concerning Pressure Fall Off Testing. Hard copy to be mailed. Please let me know if there is anything else you might need.
Thank you for your help on this, Randy

Lewis R. (Randy) Dade
Environmental Specialist
The HollyFrontier Companies
501 E. Main / P.O. Box 159
Artesia, NM 88210 / 88211-0159
575-746-5281 (o)
575-703-4735 (c)
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Email: Lewis.Dade@hollyfrontier.com

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April 16, 2019

Mr. Carl Chavez, CHMM
NM Energy, Minerals & Natural Resources Department
Oil Conservation Division, Environmental Bureau
1220 South St. Francis Dr.
Santa Fe, NM 87505-5472

RE: 2019 Fall Off Testing for Wells WDW-1, WDW-2, WDW-3 and WDW-4
HollyFrontier Navajo Refining LLC

Dear Mr. Chavez,

As per our conversation on March 26, 2019 concerning Pressure Fall Off Testing (FOT) of Navajo's UIC program injection wells. Navajo is proposing performing FOT on wells WDW-1, WDW-2 and WDW-3 for the 2019 period and adding well WDW-4 starting in 2020.

WDW-4, (30-015-44677) had the initial FOT performed in October 2018. The test was performed on the newly drilled open hole formation with an injection rate of 420 gpm of 8.9 ppg fluid for approximately 9 hours. The well was shut in and the pressure falloff was monitored for 24 hours. This data gathered during this test showed that WDW-4 would exceed the initial reservoir modeling resulting in lower injection pressures and have a smaller cone of influence and lower pressure buildup as originally calculated in the original permit. WDW-4 was put into service on January 16, 2019 and has been in continual service since that date.

Please find enclosed the initial FOT for WDW-4 (UICI-8-4) and C-115's for all four wells for January, February and March 2019. WDW-4 has injected a total of 710,571 barrels through March 31st, 2019 with a monthly average of 236,857 barrels per month. The injection pressure is averaging 62.7 psig. Navajo requests that the 2020 Fall Off Tests occur in the second and third quarters of 2020 to have all four wells on the same testing schedule. This will allow for collection of 18 months of injection data for WDW-4. WDW-4 has been performing to our expectations and Navajo feels that there is little to no benefit in performing a FOT on WDW-4 with less than one full year of quality data.

If there are any questions, please contact Scott Denton at 575-746-5487.

Respectfully,

Scott M. Denton
Environmental Manager
HollyFrontier Navajo Refining LLC

HollyFrontier Navajo Refining LLC
501 East Main • Artesia, NM 88210
(575) 748-3311 • <http://www.hollyfrontier.com>

**2018 PRESSURE FALLOFF TEST REPORT
NAVAJO REFINING, LLC**

WASTE DISPOSAL WELL WDW-4

Artesia, NM

October 2018

Houston, TX



Project No. 192080D

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- | | |
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| B. | GAUGE CALIBRATION CERTIFICATES |

ATTACHMENT

CD CONTAINING RAW PRESSURE AND TEMPERATURE DATA

CERTIFICATION STATEMENT

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Client: Navajo Refining LLC.
Well Name: WDW-1
Test Dates: August 15, 2018 to August 16, 2018

Name: Ted L. Jose
Title: Project Engineer

Phone Number: 281-589-5900

Signature _____ Date Signed _____
Texas Professional Engineer
License No. 121609

WSP USA Inc.
Texas Engineering Firm F-2263

EXECUTIVE SUMMARY

WSP USA Inc. (WSP) performed the initial pressure falloff test on Navajo Refining, LLC's (Navajo) newly drilled and completed Waste Disposal Well No. 4 (WDW-4) from August 15, 2018 to August 16, 2018.

Because the "Post Construction" parameters exceed the parameters of the reservoir model used in the permit application, the cone of influence and pressure buildup were not recalculated because the reservoir model in the permit application is sufficient. The "Post Construction" parameters that exceed the reservoir model will result in a lower injection pressure and therefore a smaller cone of influence and lower pressure buildup as calculated in the permit application.

1.0 INTRODUCTION

WSP conducted the initial pressure falloff test on WDW-4 as part of the well testing operations during the installation of the well. The 2018 pressure falloff testing was conducted in accordance with the pressure falloff testing procedure outlined in the approved Permit Application.

2.0 REPORT OF FIELD OPERATIONS

All depths in this report are referenced to the drilling rig rotary kelly bushing (RKB), which is 20 feet above ground level. The as-built wellbore schematic is presented in Figure 1.

Field operations began on August 15, 2018. Renegade Wireline Services (Renegade) rigged up on and ran downhole memory gauges to 10,327 feet RKB. Cudd was rigged up and pumped 4783 barrels of 8.9 ppg fluid into the well at a rate of 420 gpm for approximately nine hours. The well was shut in and the pressure falloff was monitored for 24 hours.

On August 16, 2018, the bottom-hole pressure gauges were pulled out of the well and static pressure gradient stops were made at 1000-foot intervals while pulling the gauges out of the well. The gauge calibration certificates are presented in Appendix A.

3.0 PRESSURE FALLOFF ANALYSIS

Pressure falloff testing was conducted on WDW-4 from August 15, 2018 to August 16, 2018. WDW-4 was shut in at 1700 hours on August 15, 2018 and the falloff data were recorded for 24 hours. Pertinent pre-test information is presented in Table 1.

Injection Period

The injection period used in the analysis was based on the injection period on August 15, 2018 where 4783 barrels of 8.9 ppg fluid into the well at a rate of 10 bpm or 420 gpm for approximately nine hours. Pertinent data relevant to the injection period are presented in Table 2.

Falloff Period

WDW-4 was shut in at 1700 hours on August 15, 2018 and remained shut-in for 24 hours while bottom-hole pressure and temperature were recorded. The pressure and temperature data recorded during the pressure falloff test are included in Attachment A. Pertinent data relevant to the falloff period are presented in Table 3.

Analysis of Falloff Test

The pressure data obtained during the falloff test were analyzed utilizing the commercially available pressure transient analysis software program PanSystem[®]. Figure 2 shows the pressure response recorded by the surface pressure tool from the time the tool was in place through the 24-hour shut-in period. Figure 3 is a Cartesian plot of the pressure data recorded during the falloff period. The superposition time function was used to account for rate changes occurring during the injection period.

Figure 4 is a log-log diagnostic plot of the falloff data, showing change in pressure and pressure derivative versus elapsed shut-in time. Radial flow begins to appear at an elapsed shut-in time of 0.108 hours and continues until 0.996 hours.

The reservoir permeability was determined from the radial flow region of the superposition Horner plot (Figure 5). The radial flow regime begins at a superposition Horner time of 69.68 and continues to 7.44. Figure 6 shows an expanded view of the superposition Horner plot. The slope of the radial flow period was determined to be 0.6089 psi/cycle.

An estimate of mobility-thickness, kh/μ , for the reservoir was determined from the following equation:

$$\frac{k}{\mu} h = 162.6 \frac{q B}{m}$$

where,

kh/μ = formation mobility-thickness, millidarcy-feet/centipoise

- q = rate prior to shut-in, BPD
 B = formation volume factor, reservoir volume/surface volume
 m = slope radial flow period, psi/cycle

With the following values, the mobility-thickness was found to be 3,845,360 md-ft/cp:

- q = 420 gpm = 14,400 barrels/day
 m = 0.6089 psi/cycle
 B = 1.0 reservoir barrel/surface barrel

$$\frac{k h}{\mu} = 162.6 \frac{(14,400)(1.0)}{0.6089}$$

$$= 3,845,360 \text{ md-ft/cp}$$

The permeability-thickness, kh , was determined to be 2,191,855 md-ft by multiplying the mobility-thickness, kh/μ , by the viscosity of the reservoir fluid, μ_{res} of 0.57 centipoise:

$$k h = \left(\frac{k h}{\mu} \right) \mu_{res}$$

$$= 3,845,360 \times 0.57$$

$$= 2,191,855 \text{ md-ft}$$

The average reservoir permeability using the total sand thickness of 330 feet was determined to be 6642 md:

$$k = \frac{(kh)}{h}$$

$$= \frac{2,191,855}{330}$$

$$= 6642 \text{ md}$$

The skin factor was determined from the following equation:

$$s = 1.151 \left[\frac{P_{wf} - P_{1hr}}{m} - \log \left(\frac{k}{\phi \mu c_i r_w^2} \right) + 3.23 \right]$$

where,

s	=	formation skin damage at open perforations, dimensionless
1.151	=	constant
p_{wf}	=	flowing pressure immediately prior to shut-in, psia
p_{thr}	=	pressure determined by extrapolating the radial flow semi-log line to a Δt of one hour, psi
m	=	slope of the radial flow semi-log line, psi/cycle
k	=	permeability of the formation, md
ϕ	=	porosity of the injection interval, fraction
μ	=	viscosity of the fluid the pressure transient is traveling through, centipoise
c_t	=	total compressibility of the formation plus fluid, psi^{-1}
r_w	=	radius of the wellbore, feet
3.23	=	constant

The final flowing pressure was 4523.64 psia. The pressure determined by extrapolating the radial flow semi-log line to a Δt of one hour, p_{thr} , was 4520.96 psia. The porosity of the injection interval, ϕ , is 0.25 and the total compressibility, c_t , is $8.4 \times 10^{-4} \text{ psi}^{-1}$. The wellbore radius, r_w , is 0.3532 feet. Using these values in addition to the previously determined parameters, m and k, results in a skin of -3.47:

$$s = 1.151 \left[\frac{4523.64 - 4520.96}{0.6089} - \log \left(\frac{6642}{(0.25)(0.57)(8.4 \times 10^{-4})(0.3532)^2} \right) + 3.23 \right]$$

$$= -3.47$$

The results of the pressure falloff analysis are summarized in Table 4. The output from the PanSystem analysis software is presented as Appendix A.

4.0 BOTTOM-HOLE PRESSURE MEASUREMENT AND STATIC GRADIENT SURVEY

On August 16, 2018, the downhole pressure memory tools were pulled out of WDW-4, and a static pressure gradient survey was performed at 1000-foot intervals to the surface. The bottom-hole pressure and temperature, after 24 hours of shut-in at 10,327 feet, were 4519.13 psia and 165.44°F, respectively. The pressure and temperature data recorded during the static pressure gradient survey are included in Attachment A. A tabulation of the survey results is provided as Table 5. The data are depicted graphically in Figure 7.

The bottom-hole pressure gauge calibration certificate is presented in Appendix B and shows the gauge has been calibrated as specified by the gauge manufacturer.

5.0 COMPARISON TO APPROVED PERMIT

WSP performed the initial pressure falloff test on WDW-4 from August 15, 2018 to August 16, 2018. The results of the pressure falloff analysis indicate a reservoir mobility-thickness, kh/μ of 3,844,211 md-ft/cp and a permeability, k , of 6642 md. Analysis of logs indicates the average porosity of the injection interval is 25%. The net open-hole thickness is 330 feet.

The following table compares the parameters used in the permit application to the parameters determined following construction of the well:

Parameter	Permit Application	Post Construction
Permeability, md	32	6642
Thickness, feet	75	330
Porosity, percent	8.5	25
Temperature, °F	141*	141
Viscosity, cp	0.57	0.57

*BHT just below the at top of injection interval at 10,320 feet KB

Because the "Post Construction" parameters exceed the parameters of the reservoir model used in the permit application, the cone of influence and pressure buildup were not recalculated because the reservoir model in the permit application is sufficient. The "Post Construction" parameters that exceed the reservoir model will result in a lower injection pressure and therefore a smaller cone of influence and lower pressure buildup as calculated in the permit application.

TABLE 1
PRE-TEST PERIOD

PRE-TEST PERIOD	
Date of Test	August 15, 2018 to August 16, 2018
Shut-in Time Prior to Test	New Well
Stabilized Pressure Prior to Test	4517.25 psia
Stabilized Temperature Prior to Test	140.59°F
Cumulative Injection Into Completed Interval	200,886 gallons
Wellbore Radius	0.3532 feet
Completed Interval	10,327 feet to 10,700 feet
Type of Completion	Open-Hole
Formation Fluid Viscosity	0.57 centipoise
Porosity	0.25
Total Compressibility	$8.4 \times 10^{-6} \text{ psi}^{-1}$
Formation Volume Factor	1 RB/STB
Initial Bottom-Hole Pressure	4517.25 at 10,327 feet
Initial Bottom-Hole Temperature	140.59°F at 10,327 feet

TABLE 2
INJECTION PERIOD

INJECTION PERIOD	
Time of Injection Period	8.58 hours
Test Fluid	8.9 ppg brine water
Injection Rate	420 gpm
Final Injection Pressure	4523.64 psia
Final Injection Temperature	90.67°F
Gauge Type	Spartek Systems
Gauge Serial No.	79513
Accuracy	0.03% of Full Scale
Resolution	0.01% of Full Scale
Gauge Depth	10,327 feet RKB

TABLE 3
FALLOFF PERIOD

FALLOFF PERIOD	
Total Shut-in Time	24 hours
Final Shut-in Pressure	4519.13 psia at 10,327 feet RKB
Final Shut-in Temperature	165.44°F @ 10,327 feet RKB

CHARIS Ltd.

GAS MEASUREMENT

CALIBRATION CERTIFICATE	
Cert Date:	9/26/2018
Due Date:	9/26/2019

This is to verify that this instrument has been inspected and tested against Aditel Digital Guage ADT GP20K, Serial#21817080004 Calibrate (6/16/17). Reference Standard Serial#11-218 Certified Traceable to NIST. Calibrated in accordance with ISO9000 Quality Standards

Customer:	MAN WELDING
Model:	TECHICAL 8"
Serial:	03786

This instrument is certified to be accurate within +/- 1% of Full Scale

Input Type/Range: 10,000#		Color: RED	
Pen Number: 2			
Ascending	Descending		
Applied:	Reading	Applied:	Reading:
0	0	10043	10000
2004	2000	8047	8000
5014	5000	5036	5000
8048	8000	2004	2000
10043	10000	0	0

Input Type/Range:		Color:	
Pen Number:			
Ascending	Descending		
Applied:	Reading:	Applied:	Reading:

Input Type/Range:			
Pen Number:			
Ascending	Descending		
Applied:	Reading:	Applied:	Reading:

2031 TRADE DR.
MIDLAND, TX 79706
(432) 697-7801 (432) 520-3564 Fax

Technician:

Luciana Lopez

9.15 PRESSURE FALLOFF ANALYSIS REPORT

District I
1625 North French, Hobbs, NM 88241

District II

811 S. First St., Artesia, NM 88210

District III

1000 Rio Brazos, Aztec, NM 84710

State of New Mexico
Energy, Minerals & Natural Resources Department

OIL CONSERVATION DIVISION

1220 South Saint Francis Drive
Santa Fe, NM 87505

OPERATOR'S MONTHLY REPORT

Form C-115 First Page
Revised January 22, 2004

Instruction on Reverse Side

1 ☐ Amended Report

2 Operator **NAVAJO REFINERY CO.**

3 OGRID: 15694

1/2019

5 Address: 501 E. MAIN PO BOX 159, ARTESIA, NM. 88210

6 Page 1 of 4

		INJECTION		PRODUCTION					DISPOSITION OF OIL, GAS, AND WATER							
<u>7</u> POOL NO. AND NAME Property No. and Name Well No. & U-L-S-T-R API No.	8 C O D E	9 Volume	10 Pressure	11 C O D E	12 Barrels of Oil/conden- sate produced	13 Barrels of water produced	14 MCF Gas Produced	15 Days Prod- uced	16 C O D E	17 Point of Disposition	18 Gas BTU or Oil API Gravity	19 Oil on hand at beginning of month	20 Volume (Bbls/mcf)	21 Transporter Ogrid	22 C O D E	23 Oil on hand at end of month
96918 NAVAJO PERMO-PENN																
30-015-27592 WDW - 1	D	263,589	1,272 W													
<u>30-015-20894 WDW - 2</u>	D	75,463	1,262 W													
78890 ILLINOIS CAMP; MORROW NORTH																
30-015-26575 WDW - 3	D	92,469	1,177 W													
96101 SWD-DEVONIAN 30-015-44677 WDW-4	D	202560	58 W													

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.
24

Signature L. R. DADE ENVIR. SPEC. Printed Name & Title Lewis Dade@hollyfronter.com E-Mail Address Date 0 575-746-5281 Phone Number

2 Operator

NAVAJO REFINERY CO.

3 OGRID:

15694

2/2019

5 Address:

501 E. MAIN PO BOX 159, ARTESIA, NM. 88210

6 Page 1 of 4

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96918 NAVAJO PERMO-PENN																
30-015-27592 WDW - 1	D	188,160	1,270 W													
30-015-20894 WDW - 2	D	61,440	1,252 W													
78890 ILLINOIS CAMP; MORROW NORTH																
30-015-26575 WDW - 3	D	66,240	1,116 W													
96101 SWD-DEVONIAN																
30-015-44677 WDW-4	D	228480	50 W													

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.

Signature

L. R. DADE

ENVIR. SPEC.

Lewis.Dade@hollyfronter.com

Date

0

575-746-5281

Printed Name & Title

E-Mail Address

Phone Number

District I
1825 North French, Hobbs, NM 88241

District II
811 S. First St., Artesia, NM 88210

District III
1000 Rio Brazos, Aztec, NM 84710

State of New Mexico
Energy, Minerals & Natural Resources Department
OIL CONSERVATION DIVISION
1220 South Saint Francis Drive
Santa Fe, NM 87505

OPERATOR'S MONTHLY REPORT

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		INJECTION		PRODUCTION					DISPOSITION OF OIL, GAS, AND WATER							
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96918 NAVAJO PERMO-PENN																
30-015-27592 WDW - 1	D	132,857	1,184 W													
30-015-20894 WDW - 2	D	53,143	1,157 W													
78890 ILLINOIS CAMP; MORROW NORTH																
30-015-26575 WDW - 3	D	59,520	1,064 W													
96101 SWD-DEVONIAN																
30-015-44677 WDW-4	D	279531	80 W													

I hereby certify that the information contained in this report is true and complete to the best of my knowledge.
24

Signature L. R. DADE ENVIR. SPEC. Lewis.Dade@hollyfronier.com Date 0 575-746-5281
Printed Name & Title E-Mail Address Phone Number

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD
Sent: Friday, January 11, 2019 2:52 PM
To: Denton, Scott (Scott.Denton@HollyFrontier.com); Holder, Mike (Mike.Holder@hollyfrontier.com); Dade, Lewis (Randy); Combs, Robert (Robert.Combs@hollyfrontier.com)
Cc: Sanchez, Daniel J., EMNRD; Griswold, Jim, EMNRD; Goetze, Phillip, EMNRD; Bratcher, Mike, EMNRD
Subject: Navajo Refining, LLC WDW-4 (UICI-8-4) API# 30-015-44677 Oil Conservation Division UIC Class I (Non-hazardous) Disposal Well AUTHORIZATION TO INJECT

Mr. Denton, et al.:

The New Mexico Oil Conservation Division (OCD) has completed its review of the “Drill Report WDW-4 May 2018 – August 2018” (Report) submitted under HollyFrontier Navajo Refining L.L.C. (Navajo) cover letter dated November 13, 2018. In addition, Navajo has responded and satisfactorily addressed all subsequent OCD Report and Water Quality Control Commission (WQCC) UIC Class I (Non-hazardous) Disposal Well discharge permit related questions, concerns, clarifications, etc. etc.

OCD has determined Navajo has met the current and/or applicable requirements of WQCC 20.6.2.5000 through 20.6.2.5399 NMAC in addition to other applicable requirements of the commission regulations, i.e., 19.15.26 NMAC. Navajo is hereby **authorized to inject** into WDW-4.

OCD would like to thank Navajo for its excellent communication, cooperation and technical efforts throughout the OCD WQCC Discharge Permit Process.

Please contact me if you have questions.

Mr. Carl J. Chavez, CHMM (#13099)
New Mexico Oil Conservation Division
Energy Minerals and Natural Resources Department
1220 South St Francis Drive
Santa Fe, New Mexico 87505
Ph. (505) 476-3490
E-mail: CarlJ.Chavez@state.nm.us

“Why not prevent pollution, minimize waste to reduce operating costs, reuse or recycle, and move forward with the rest of the Nation?” (To see how, go to: <http://www.emnrd.state.nm.us/OCD> and see “Publications”)

ECONOMICALLY RECOVERABLE HYDROCARBON, INJECTION POTENTIAL AND PROTECTION OF CORRELATIVE RIGHTS EVALUATION

HollyFrontier Navajo Refining LLC

SWDW #4

API# 30-015-44677

Section 23, Twp. 17S-27E

Eddy County, New Mexico

Prepared for

HollyFrontier Navajo Refining LLC

Artesia, New Mexico

by

Geolex, Inc.

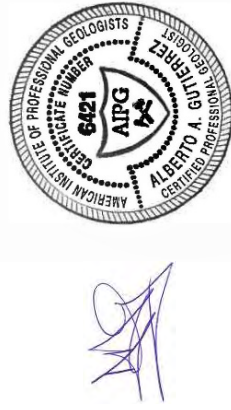
500 Marquette, NW, Suite 1350

Albuquerque, NM 87102

January 11, 2019

I, Alberto A. Gutierrez, RG, as a professional geologist have examined and analyzed the available data in the vicinity of Navajo SWDW#4 (API # 30-015-44677). The results of this analysis is presented in this report prepared by me and under my direct supervision.

Based on the results of the analyses presented below, it is my professional opinion that there are no economically recoverable hydrocarbons in the permitted injection zone. Furthermore, I hereby certify that the operation of this well as permitted for injection will not adversely affect the correlative rights of adjacent mineral owners or leasees.



Dated January 11, 2019

I, Louis J. Mazzullo, RG, as a Certified Petroleum Geologist, have examined and analyzed the available data in the vicinity of Navajo SWDW#4 (API # 30-015-44677). The results of this analysis is presented in this report prepared by me.

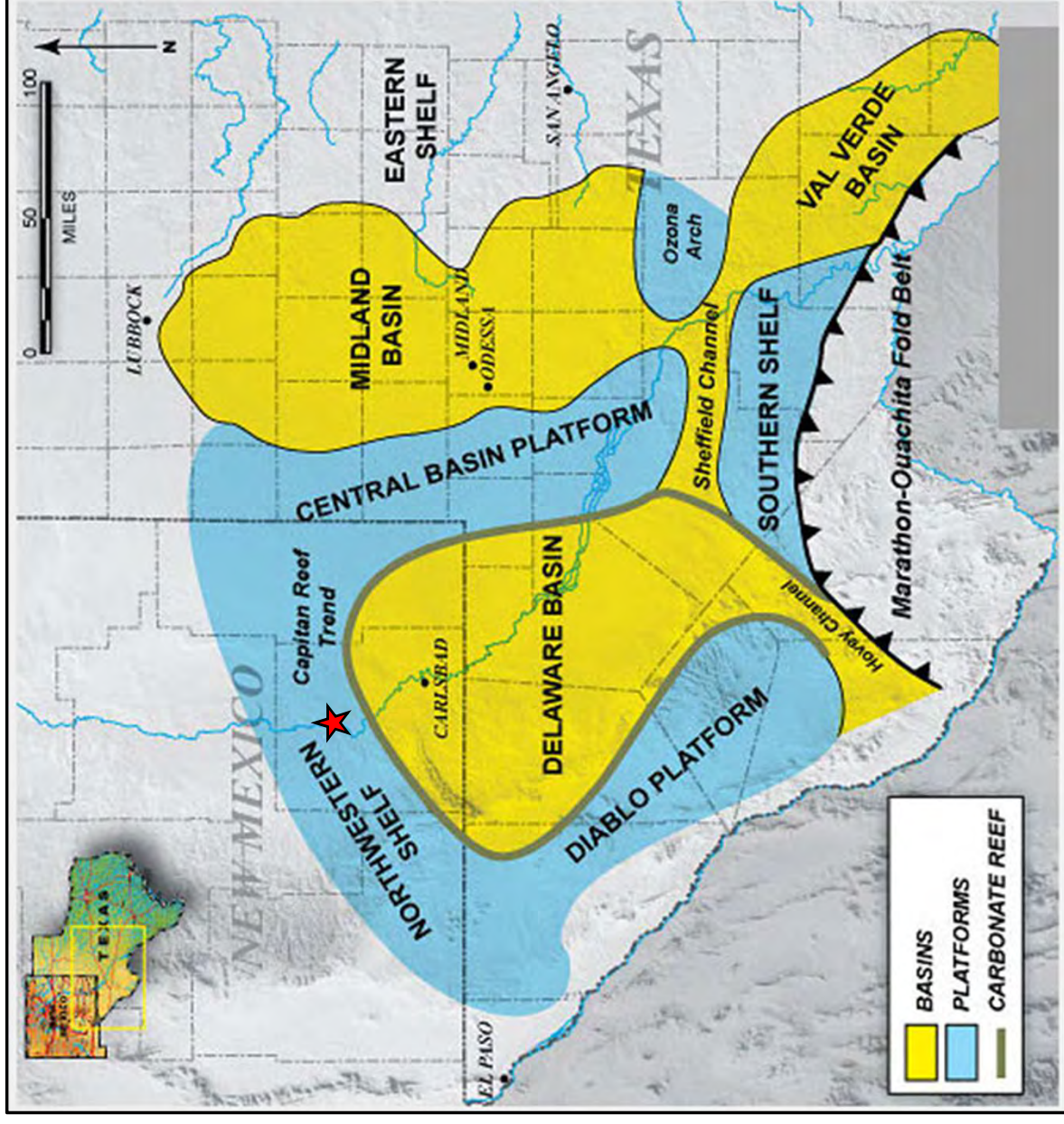
Based on the results of the analyses presented below, it is my professional opinion that there are no economically recoverable hydrocarbons in the permitted injection zone. Furthermore, I hereby certify that the operation of this well as permitted for injection will not adversely affect the correlative rights of adjacent mineral owners or leasees.

A handwritten signature in blue ink, likely belonging to Louis J. Mazzullo, is shown above the printed name and title.

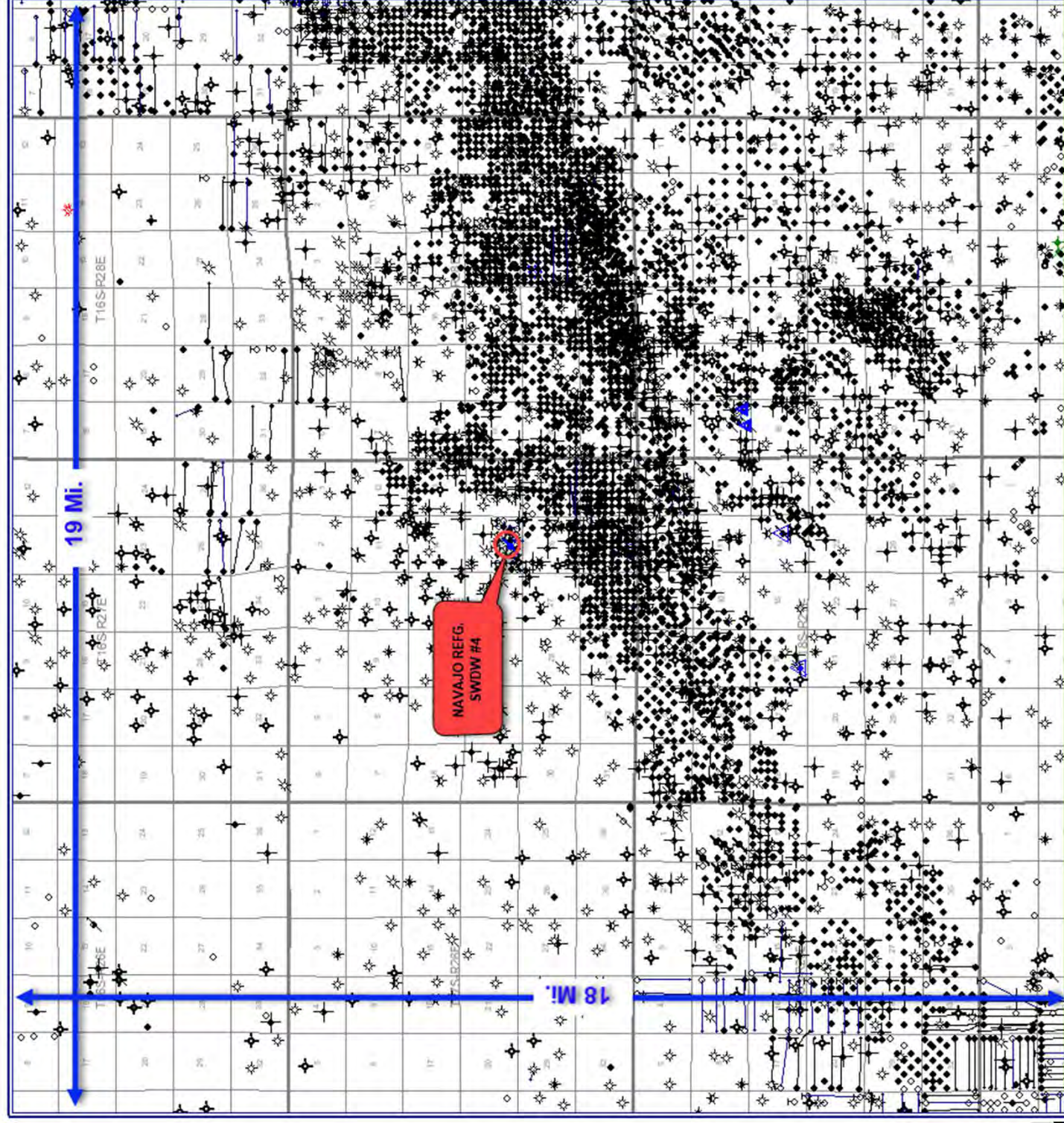
Certified Petroleum Geologist #4693
American Association of Petroleum Geologists (AAPG)

GEOLOGIC SETTING OF SWDW #4 (RED STAR)

The SWDW #4 (API# 30-015-44677) is located on the Northwest Shelf of the Delaware Basin sub-province of the Permian Basin, near Artesia, New Mexico.

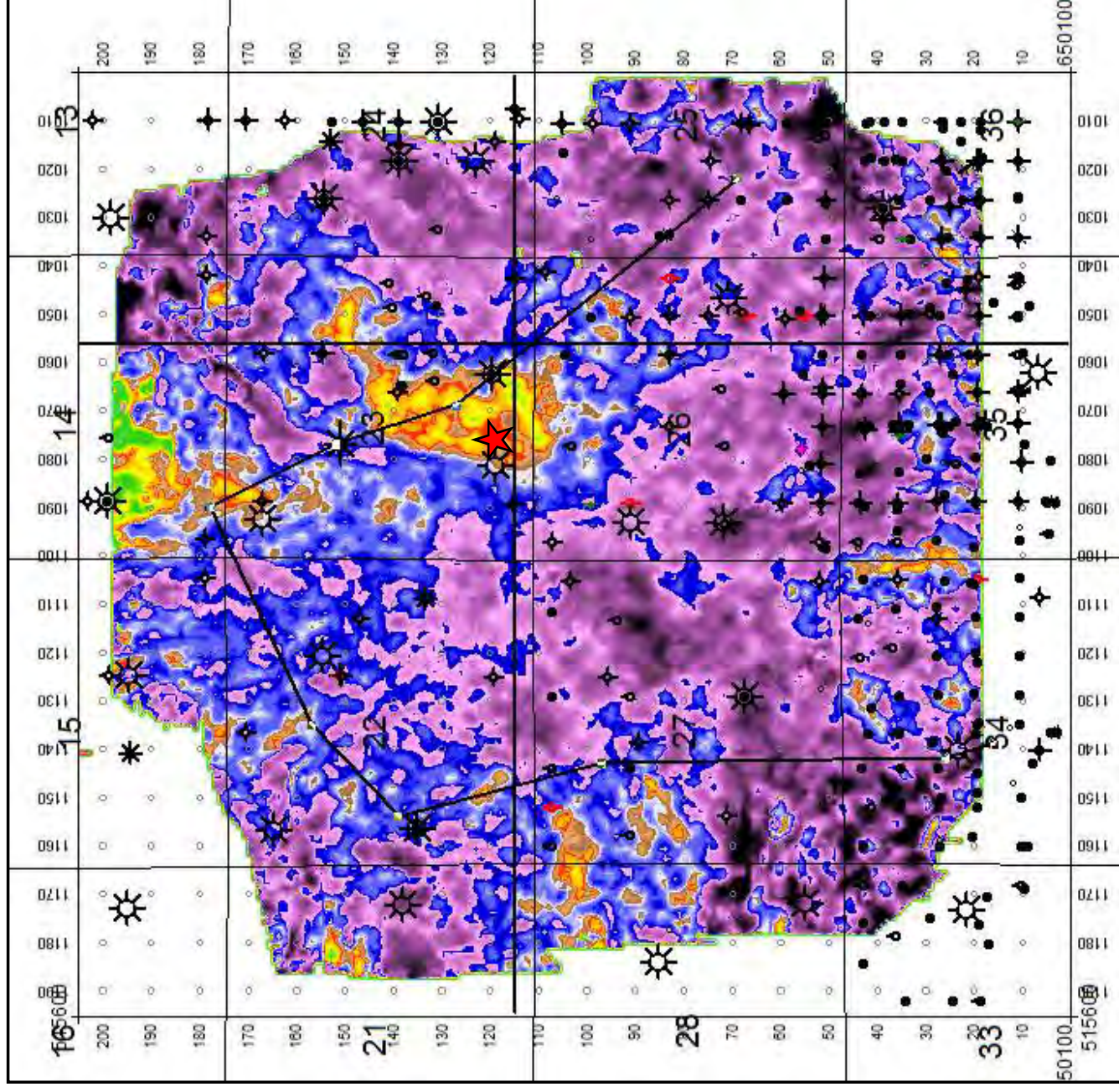


The Navajo Refining Co. SWDW #4 (API# 30-015-44677) is located on the northern edge of the Red Lake (Yeso) Field in Twp. 17S-27E, Section 23, in Eddy County, New Mexico. At this location, *there are or never have been any wells that produced hydrocarbons from the Silurian and Devonian formations*, and for some distance away from the boundaries of this map. The nearest Silurian Devonian production is about 21 miles to the northeast of the well, in the Little Lucky Lake area of southern Chaves County.

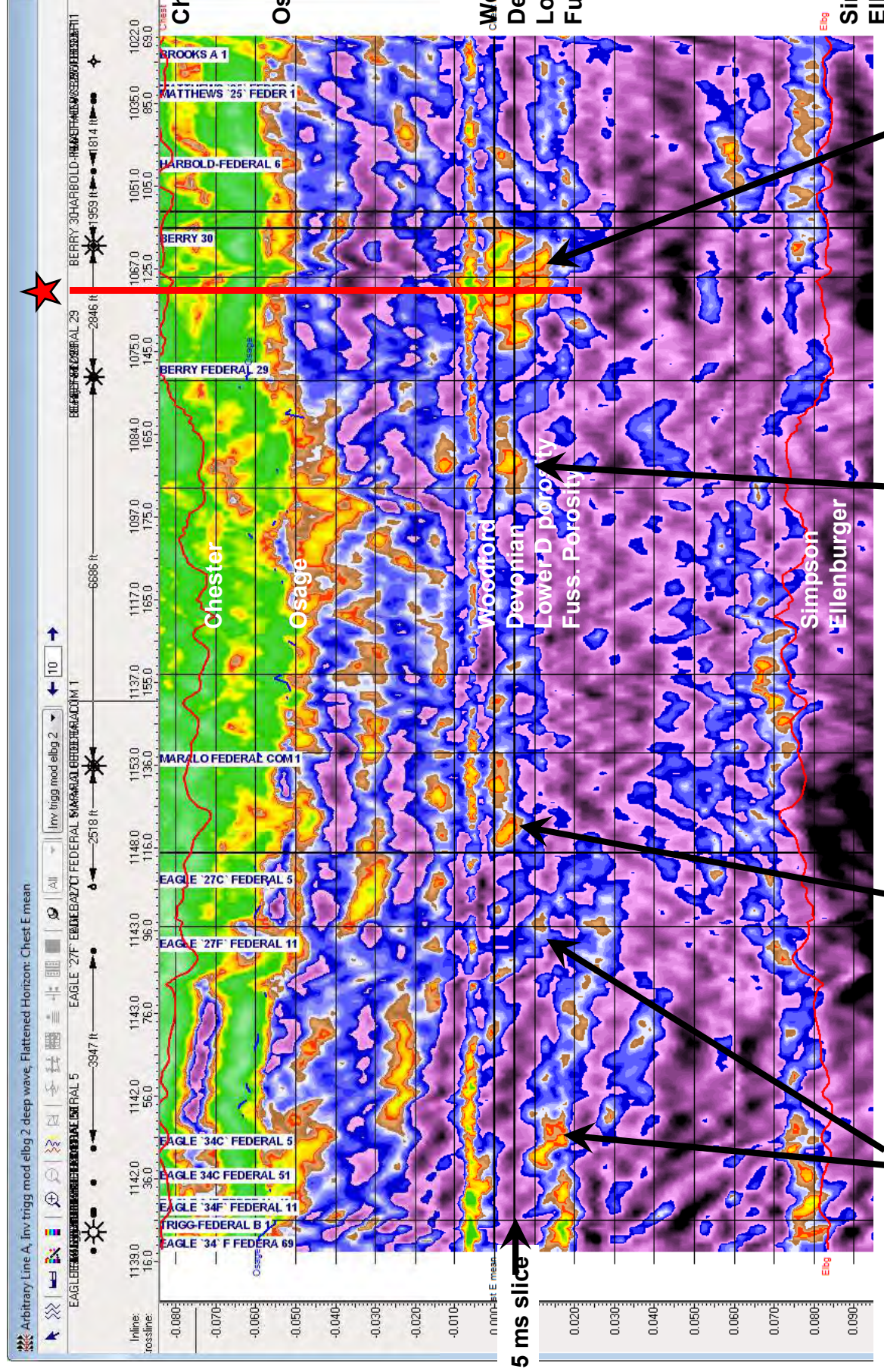


SEISMIC INVERSION SLICE THROUGH UPPER SILURO-DEVONIAN

The location for the SWDW #4 well (red star) was selected on the basis of seismic inversion analysis of a 3D seismic volume that was shot and interpreted by Geolex in 2017 for HollyFrontier. The bright warm color swatch in the vicinity of the well location represents an area of thick, high porosity within the upper Siluro-Devonian section.



FLATTENED SEISMIC TIME SLICE, UPPER SILURO-DEVONIAN



L. Dev porosity

Karst system with collapse

Karst system in Graben

Major Karst collapse

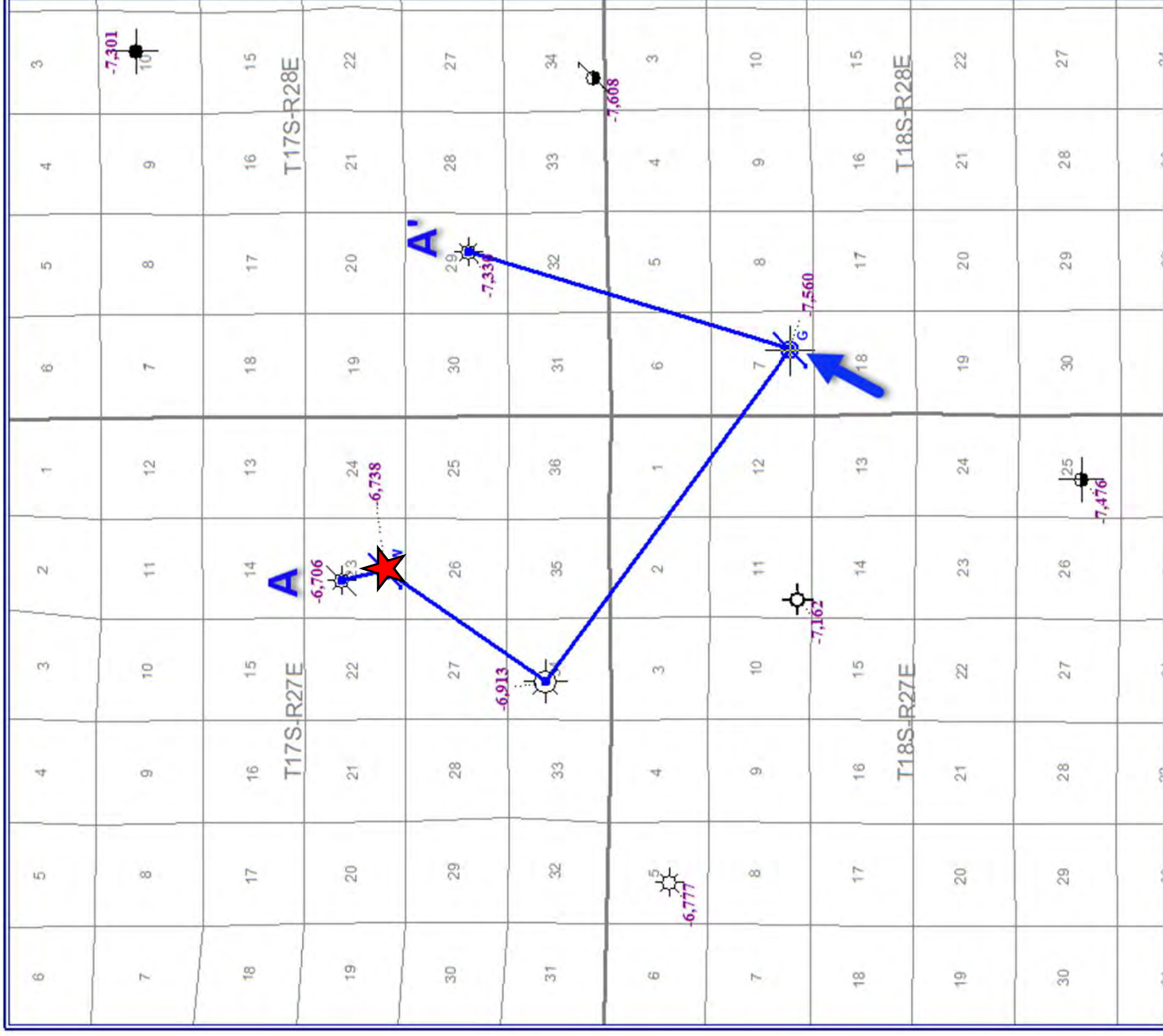
This vertical section slice through the inverted seismic volume passes through the SWDW #4(red star) location, and shows that the Siluro-Devonian here is riddled with porous, karst and karst-collapse facies that start 25-30 feet below the top of the Siluro-Devonian, with well-interconnected porosity that is evidently very vertically transmissive.

DEVONIAN OR DEEPER WELL CONTROL AROUND SWDW #4

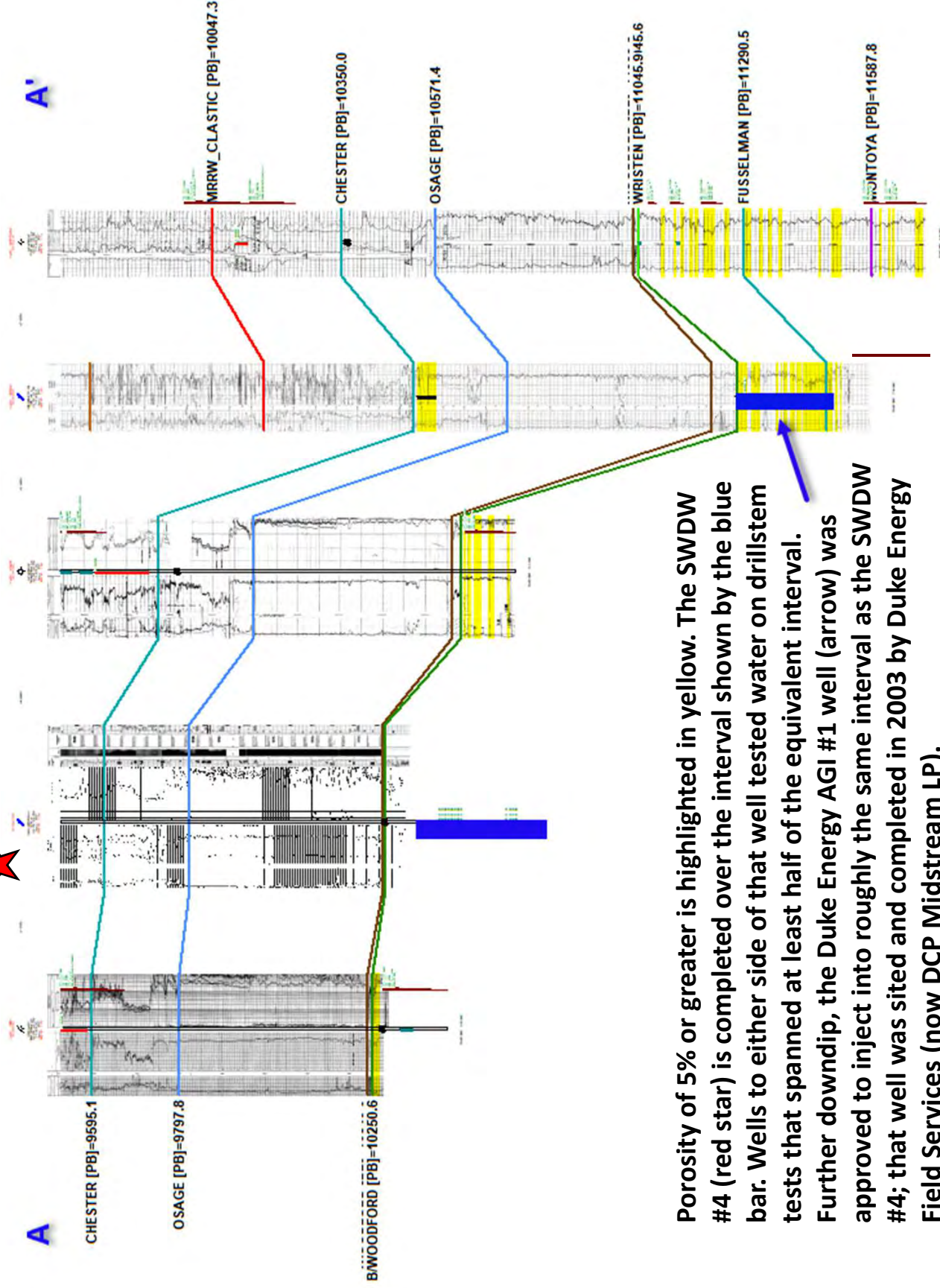
Devonian structural subseas are shown for each well.

Only a handful of wells were drilled to the Devonian or deeper in the more immediate area of the subject well (red star). One of these wells is an active acid gas injection (AGI) well operated by DCP Midstream (arrow). The SWDW #4 is one of the structurally higher wells on top of the Devonian. *None of the wells on this map had hydrocarbon shows in the Siluro-Devonian, and most tested wet in the upper Siluro-Devonian by drillstem tests and/or through perforations.*

Cross-section A-A', indexed here and presented on the next slide, illustrates the structure and geology of the Siluro-Devonian section in the area.

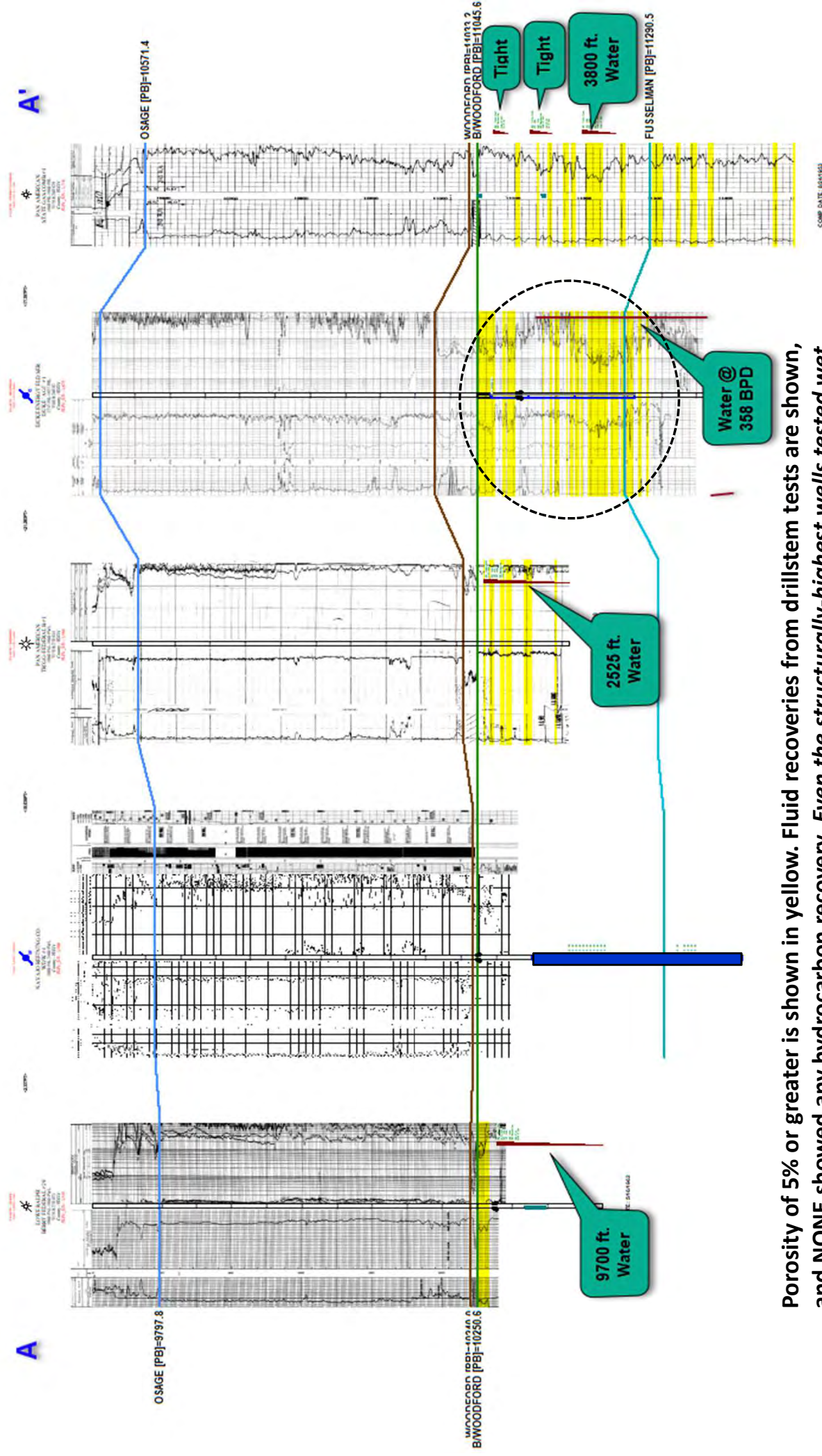


STRUCTURAL CROSS-SECTION INCORPORATING DEEP PENETRATIONS



Porosity of 5% or greater is highlighted in yellow. The SWDW #4 (red star) is completed over the interval shown by the blue bar. Wells to either side of that well tested water on drillstem tests that spanned at least half of the equivalent interval. Further down dip, the Duke Energy AGI #1 well (arrow) was approved to inject into roughly the same interval as the SWDW #4; that well was sited and completed in 2003 by Duke Energy Field Services (now DCP Midstream LP).

STRATIGRAPHIC CROSS-SECTION INCORPORATING DEEP PENETRATIONS

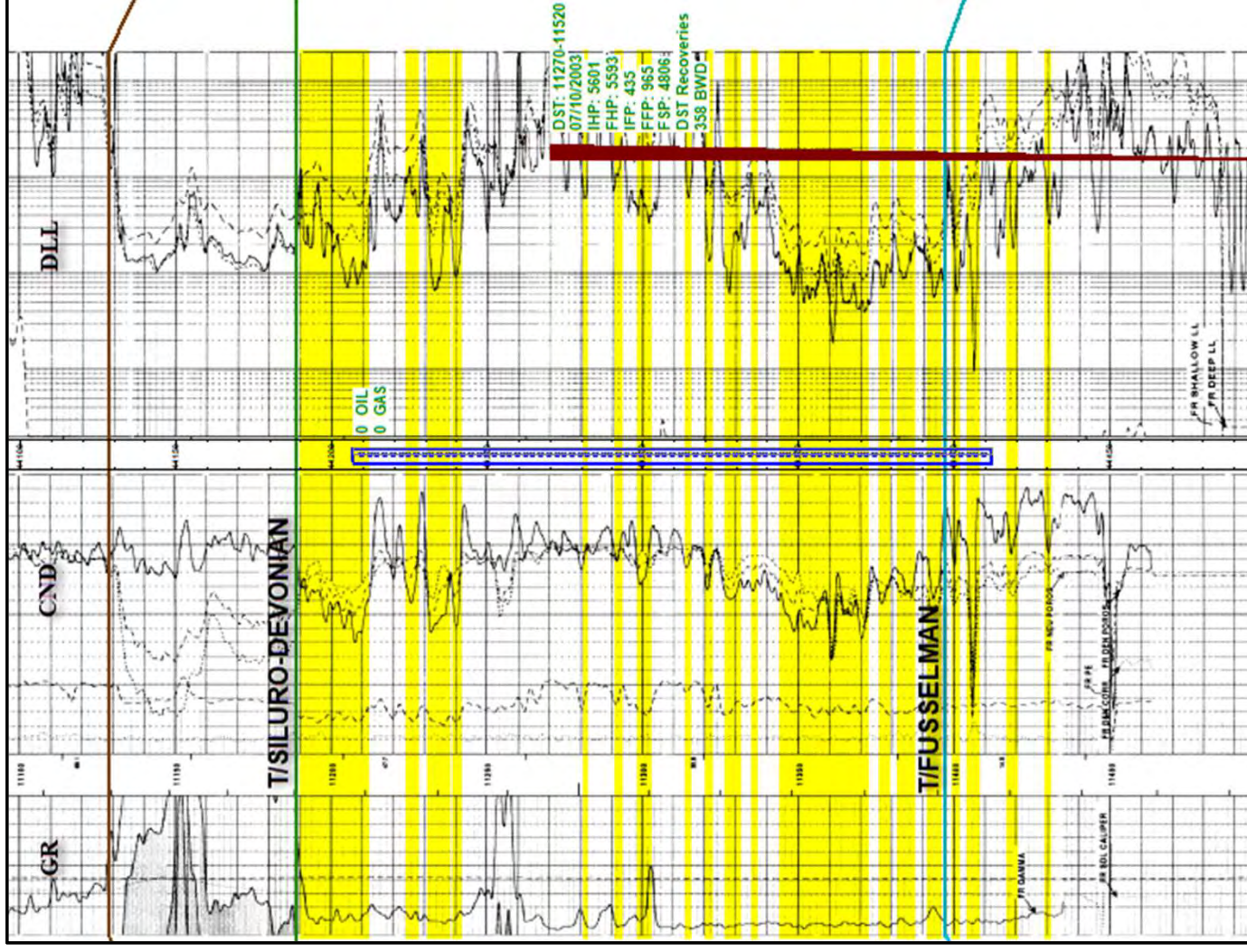


Porosity of 5% or greater is shown in yellow. Fluid recoveries from drillstem tests are shown, and NONE showed any hydrocarbon recovery. *Even the structurally-highest wells tested wet across the intended injection interval of the SWDW #4 (blue bar).* Although the SWDW #4 was not logged through the intended injection interval, its section is equivalent to the structurally-lower Duke AGI #1 well, whose log section (dashed black outline) is shown on the next slide.

LOG COMPOSITE SECTION, DUKE AGI #1

An open-hole drillstem test was run across the interval shown, and recovered water at a calculated rate of 358 barrels per day. Casing was then set and cemented, and perforations shot as shown. *The perforations were given an acid frac treatment, and recovered no hydrocarbons.*

The differences in resistivity values between the upper porosity zone and those of the zone just above the Fusselman are probably the result of varying water chemistry, particularly, more sulfurous waters at the top of the Siluro-Devonian. Water recovered from the drillstem test showed 4,786 mg/l sulfate in the upper sample chamber of the test tool, decreasing with depth (see next slide). The higher resistivity readings in the uppermost porosity zone (below the top of Siluro-Devonian) are likely reflecting increased sulfates, which would give the appearance of less saline water even though the water in the upper zones are more saline.



Water chemical variances from 4 samples taken from the drillstem test of the Duke AGI #1. The highest water sample shows higher sulfates and higher salinity than samples taken lower in the section. The higher sulfates would register on a resistivity tool as higher resistivity, giving the appearance of fresher water or more oil-prone fluids. The presence of oil in the upper-most porosity zone is unlikely, because of (1) the lack of oil shows in the upper-most porosity zones in any of the other wells on cross-section A-A', especially in wells that are structurally higher than the Duke AGI #1, (2) the fact that the SWDW #4 well is structurally low to an adjacent well that tested water in the upper-most zone, and (3) there is no Siluro-Devonian production within 21 miles of the SWDW #4.

SILURO-DEVONIAN WATER ANALYSES, DUKE AGI #1

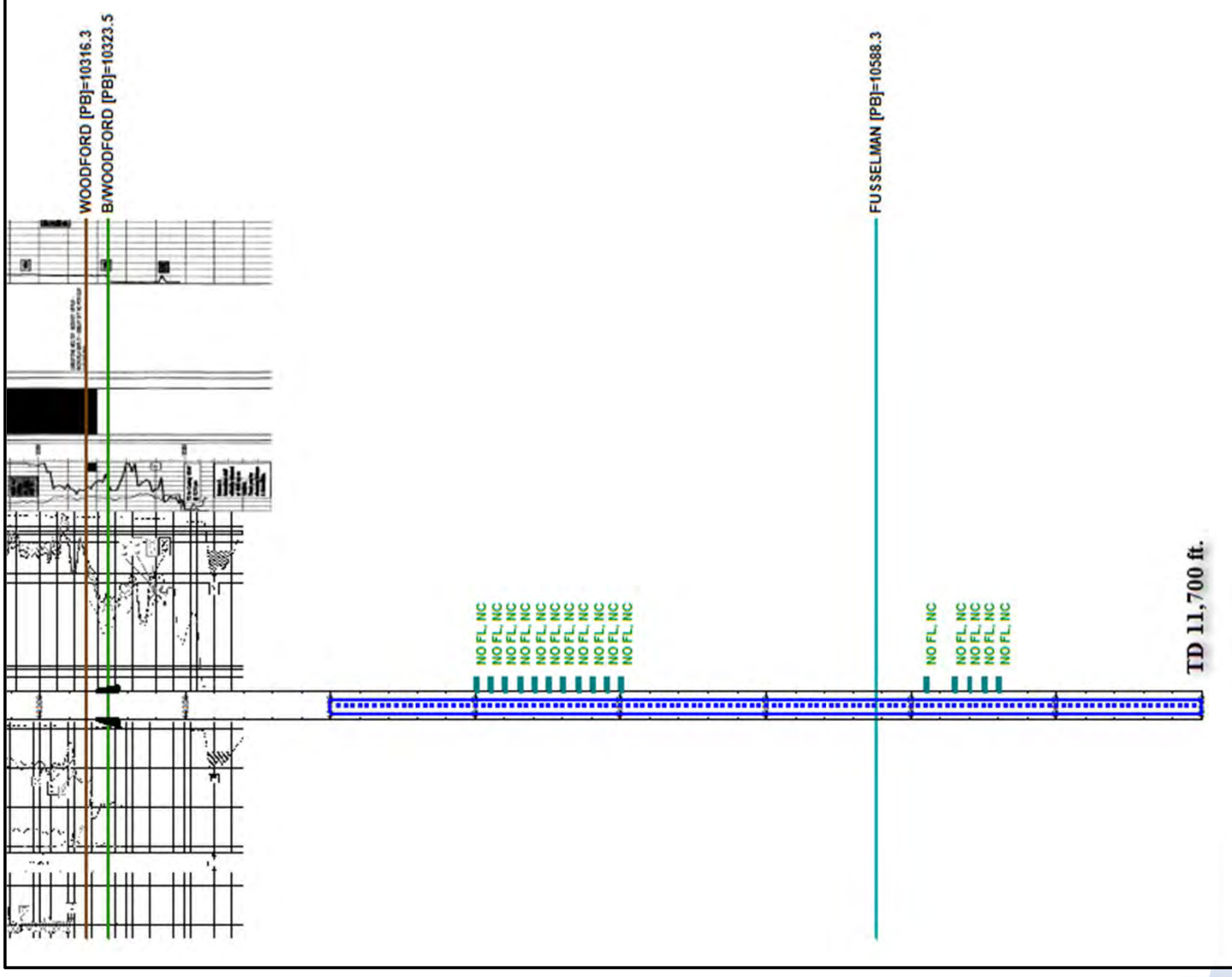
P. O. BOX 1668 MONAHANS, TEXAS 79766 PH. 943-3234 OR 953-1040		Martin Water Laboratories, Inc.		709 W. INDIANA MIDLAND, TEXAS 79701 PHONE 683-4521	
TO: Mr. Robert Wheeler		LABORATORY NO. 902-147			
P.O. Box 1642, Houston, TX 77251-1642		SAMPLE RECEIVED 9/25/02			
		RESULTS REPORTED 9/27/02			
COMPANY Duke Energy Field Services		LEASE AGI #1			
FIELD OR POOL					
SECTION 7 BLOCK SURVEY T-1858R-28E COUNTY Eddy		STATE New Mexico			
SOURCE OF SAMPLE AND DATE TAKEN:					
NO. 1 Recovered water - taken from AGI #1 (top). 9/24/02					
NO. 2 Recovered water - taken from AGI #1 (middle). 9/24/02					
NO. 3 Recovered water - taken from AGI #1 (bottom). 9/24/02					
NO. 4 Recovered water - taken from AGI #1 (upper sample chamber). 9/24/02					
REMARKS: DST #1 - Devonian					

CHEMICAL AND PHYSICAL PROPERTIES				
	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0666	1.0420	1.0420	1.0422
pH When Sampled				
pH When Received	6.95	6.21	6.41	6.37
Bicarbonate as HCO ₃	1,903	903	878	732
Supersaturation as CaCO ₃				
Undersaturation as CaCO ₃				
Total Hardness as CaCO ₃	850	4,800	4,300	4,100
Calcium as Ca	248	1,120	1,240	1,120
Magnesium as Mg	56	486	292	316
Sodium and/or Potassium	38,536	20,728	20,664	20,295
Sulfate as SO ₄	4,786	2,952	3,319	2,470
Chloride as Cl	55,380	32,660	31,950	31,950
Iron as Fe	29.6	175	353	422
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	100,908	58,849	58,343	56,882
Temperature °F.				
Carbon Dioxide, Calculated				
Dissolved Oxygen				
Hydrogen Sulfide	0.0	0.0	0.0	0.0
Reactivity, ohm-cm at 77° F.	0.096	0.144	0.145	0.147
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				

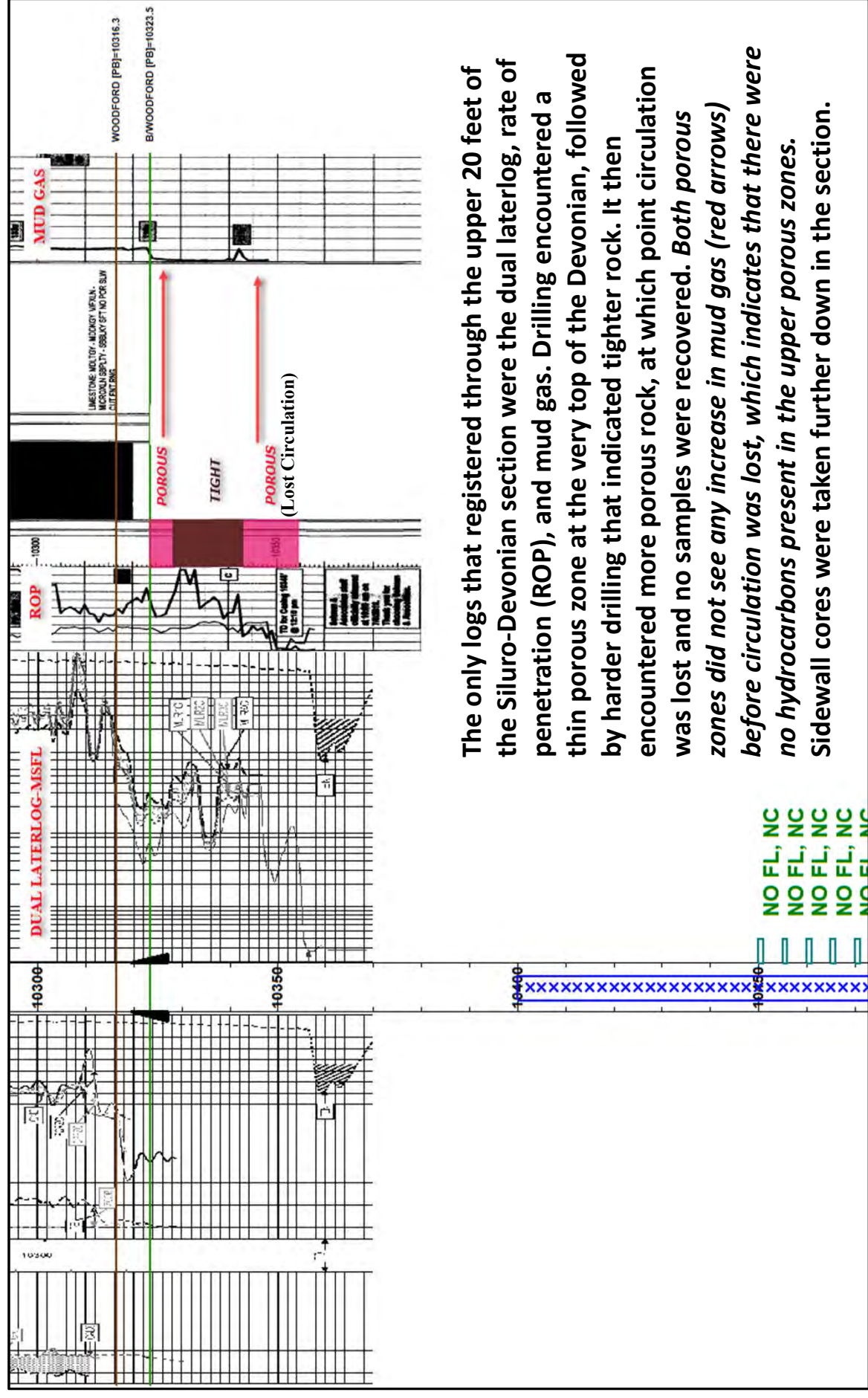
Results Reported As Milligrams Per Liter

WELL SECTION, SWDW #4

Open-hole geophysical logs were only run to the top of the Siluro-Devonian, and only the resistivity log sampled the upper 20 feet of the Devonian (see next slide). Although logs were not run in the open hole below the top of the Siluro-Devonian, sidewall cores were taken through the middle and lower parts of the intended injection interval. The sidewall cores are indicated by the green tick marks; none of the cores reported any fluorescence (NO FL) or cuts (NC).



WELL SECTION CLOSE-UP, UPPER DEVONIAN IN SWDW #4



The only logs that registered through the upper 20 feet of the Siluro-Devonian section were the dual laterlog, rate of penetration (ROP), and mud gas. Drilling encountered a thin porous zone at the very top of the Devonian, followed by harder drilling that indicated tighter rock. It then encountered more porous rock, at which point circulation was lost and no samples were recovered. *Both porous zones did not see any increase in mud gas (red arrows) before circulation was lost, which indicates that there were no hydrocarbons present in the upper porous zones.* Sidewall cores were taken further down in the section.

SIDEWALL CORE REPORT- CORE LABS

SIDEWALL CORE ANALYSIS											
			Company: WSP USA Well Name: Navajo WDW 4 Location: Eddy County, Texas Co. & St.:			Field: Formation: Coring Fluid: Elevation:			File Number: 201802772 Date: 08/17/2018 API Number: Analyst: JS, SO		
Sample Number	Sample Depth ft	Sample Received In	Permeability (Horizontal) Kair md	Porosity Helium % of BV	Saturation Oil % of PV	Saturation Water % of PV	Oil Bulk % of BV	Gas Bulk % of BV	Grain Density gm/cc	Gas Detector Units (0-250)	Description
1	10630.0	1.9	0.003	3.5	0.1	42.4	0.0	2.0	2.83	0	Dol, sl vug, 0% flu no cut
2	10625.0	2.0	0.056	2.5	0.3	68.2	0.0	0.8	2.85	0	Dol, tr vug, 0% flu no cut
3	10620.0	1.0	0.538	1.5	0.9	97.5	0.0	0.0	2.82	0	Dol, tr vug, 0% flu no cut
4	10615.0	1.1	1.570	3.8	0.4	50.0	0.0	1.9	2.84	1	Dol, sl vug, 0% flu no cut
5	10605.0	1.8	0.001	2.5	0.8	49.6	0.0	1.3	2.84	2	Dol, sl vug, 0% flu no cut
6	10500.0	1.5	162	6.2	0.3	45.7	0.0	3.3	2.85	1	Dol, tr cht, tr sul, sl vug, 0% flu no cut
7	10495.0	1.8	1.08	9.8	0.2	96.9	0.0	0.3	2.71	0	Cht, sul, dol, sl vug, 0% flu no cut
8	10490.0	1.9	1.20	6.2	0.4	95.2	0.0	0.3	2.68	0	Cht, sl dol, tr vug, 0% flu no cut
9	10485.0	1.8	62.8	11.1	0.8	96.4	0.1	0.3	2.55	1	Cht, sul, sl dol, sl vug, 0% flu no cut
10	10480.0	1.0	1.10	8.2	2.9	72.8	0.2	2.0	2.65	0	Cht, tr dol, sl vug, 0% flu no cut
11	10475.0	1.3	194	8.4	0.5	44.6	0.0	4.6	2.84	4	Dol, sl vug, 0% flu no cut
12	10470.0	1.1	0.001	9.5	0.1	23.0	0.0	7.3	2.83	1	Dol, sl vug, 0% flu no cut
13	10465.0	2.2	0.337	2.1	0.7	87.8	0.0	0.2	2.81	0	Dol, tr vug, 0% flu no cut
14	10460.0	1.8	133	4.6	0.5	52.3	0.0	2.2	2.84	23	Dol, sl vug, 0% flu no cut
15	10455.0	1.5	0.694	3.6	0.4	44.6	0.0	2.0	2.84	5	Dol, sl vug, 0% flu no cut
16	10450.0	2.5	6.510	12.3	0.1	43.3	0.0	7.0	2.83	4	Dol, vug, 0% flu no cut

Sidewall core analyses confirm variable water saturations, and only trace hydrocarbon shows. These results conclusively demonstrate the absence of economically recoverable hydrocarbons and confirm that injection into this zone will not endanger correlative rights of mineral holders or leases in the area.

SUMMARY OF RESERVOIR CHARACTERISTICS OF THE PROPOSED INJECTION INTERVAL CONCLUSIVELY DEMONSTRATES THE ABSENCE OF ECONOMICALLY RECOVERABLE HYDROCARBONS

- Injection is proposed into porous dolomites and dolomitic limestones of the Siluro-Devonian (Devonian, Wristen, Fusselman). This interval has been drillstem-tested across various zones in nearby wells, and never recovered any hydrocarbons. The injection interval in the SWDW #4 was acid-fracked and did not recover any trace of hydrocarbon.
- Mudlog gas shows across the top of the injection interval are absent, clearly indicating the lack of any movable (recoverable) hydrocarbons in the upper Siluro-Devonian section.
- Sidewall core analyses indicated variable water saturations throughout the middle and lower interval, no fluorescence, and no cuts, which also indicate the lack of recoverable hydrocarbons in the injection interval.
- The caprock which was verified by coring and logging shows that it is impermeable and adequate to contain injection fluids in the injection zone protecting correlative rights of mineral owners or leasees in overlying zones.
- Seismic inversion analyses, which were used to locate the well site and which were verified by drilling, showed well-interconnected porosity extending down-section from about 20-30 feet below the top of the Siluro-Devonian (base of Woodford) that is evidently water-wet.
- SWDW #4 is directly downdip of a well ½ mile away that tested water across 150 feet of the upper Siluro-Devonian interval and updip of the Duke AGI #1, which was successfully permitted to inject through the same interval as proposed for SWDW #4.
- **There is no production from the Siluro-Devonian within 21 miles of the well site.**

Chavez, Carl J, EMNRD

From: Denton, Scott <Scott.Denton@HollyFrontier.com>
Sent: Wednesday, March 28, 2018 10:12 AM
To: Griswold, Jim, EMNRD
Cc: Chavez, Carl J, EMNRD; Brancard, Bill, EMNRD; Holder, Mike; McWatters, Denise; Jones, Tim T.; Denton, Scott; Dade, Lewis (Randy)
Subject: WDW-4 Start of Well Installation Update

Jim,

Navajo is making significant progress on the 4th well.

- Pad Construction start date – March 11, 2018
- Conductor Pipe & Cellar Installation – March 24, 2018
- Drill Rig Mobilizing - anticipated April 4, 2018

GW-28 Section 4 lists April 30, 2018 as the “no later than” start date for installation. Based on the progress listed above, Navajo feels we have met the start requirement.

I will continue to update you on our progress. We are still working with the BLM for the Pipeline Permit. Routing of the line has changed several times due to their requests. We are making good progress there as well.

Let me know if you have any questions.

Thanks,

SMD

Scott M. Denton
Environmental Manager

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575-746-5487 (o)
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