

**STATE OF NEW MEXICO
DEPARTMENT OF ENERGY, MINERALS AND NATURAL RESOURCES
OIL CONSERVATION DIVISION**

**APPLICATION OF NGL WATER SOLUTIONS
PERMIAN, LLC FOR APPROVAL OF SALT WATER
DISPOSAL WELL IN LEA COUNTY, NEW MEXICO**

Case No. 20896
[Original Case No. 16507]

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AFFIDAVIT OF KATE ZEIGLER

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

I, Kate Zeigler, make the following affidavit based upon my own personal knowledge.

1. I am over eighteen (18) years of age and am otherwise competent to make the statements contained herein.
2. I am the senior geologist at Zeigler Geologic Consulting, and I provide a wide range of geoscience related services to companies and other entities in Southeastern New Mexico.
3. I have obtained a bachelor's degree in geology from Rice University, a master's degree in paleontology from the University of New Mexico, and a Ph.D. in stratigraphy and paleomagnetism from the University of New Mexico. Additionally, I have completed several surface geologic maps for the New Mexico Bureau of Geology and Mineral Resource's Geologic Mapping Program as well as for independent operators who are exploring prospects within the western Permian Basin. I have also conducted a prior geologic study concerning what is commonly referred to as the Devonian and Silurian formations in Southeastern New Mexico to

help determine whether the approval of 7" by 5 ½" tubing is appropriate in Devonian and Silurian salt water disposal wells approved by the New Mexico Oil Conservation Division.

4. I am familiar with the application that NGL Water Solutions Permian, LLC ("NGL") has filed in this matter, and I have conducted a geologic study of the lands which are the subject matter of the application. A copy of my geologic study, including cross sections, a structure map and isopach are is included in Attachment A to this affidavit.

5. The applicant, NGL (OGRID No. 372338), seeks an order approving the Moab SWD #1 well. This well is a salt water disposal well.

6. I have been informed that the injection interval for the well will be isolated to the Devonian and Silurian formations (also referred to as the Wristen Group and Fusselman Formation) and the well will have four strings of casing protecting the fresh water aquifer, the salt-bearing interval, and the Permian aged rocks through the Wolfcamp Formation. The deepest casing is 7 5/8", which is cemented and cement is circulated on the 7 5/8" casing.

7. The well will be spaced out and not located closer than approximately 1.5 miles from other disposal wells that have been approved for injection into the Devonian and Silurian formations.

8. The injection zone for the well is located below the Woodford Shale. The Woodford Shale is an Upper Devonian unit that has low porosity and permeability and consists predominantly of shale and mudstone with some carbonate beds. The Woodford Shale, along with other shale-dominated units above the Mississippian limestone, acts as a permeability barrier to prevent fluids from moving upward out of the underlying formations. The Woodford Shale formation in the areas where the well is located is between 150 and 200 feet thick.

9. Below the injection zone for the well is the Ordovician formation, also referred to as the Simpson Group, which contains sequences of shale that make up approximately 55% of the total thickness of the formation in any given place and can likewise act as a permeability boundary that prevents fluids from migrating downwards into deeper formations and the basement rock. In the area where the well is proposed to be located, the Ordovician formation is between 800 and 900 feet thick and, as a result, there is a significant thickness in this lower shale. Below the Ordovician is the Ellenburger Formation, which is 650 to 700 feet thick.

10. Based on my geologic study of the area, it is my opinion that the approved injection zone for the well is located below the base of the Woodford Shale formation and above the Simpson Group formation, both of which consist of significant shale deposits. Evidence indicates that shale formations located above and below the approved injection zones will likely restrict fluids from migrating beyond the approved injection zones for the wells.

11. The well will primarily be injecting fluids into the Wristen Group and Fusselman Formation, with some fluids potentially being injected into the Upper Montoya Group. Each of these rock units is located within what is commonly referred to by operators and the Division as the "Devonian-Silurian" formations. These zones consist of a very thick sequence of limestone and dolostone which has significant primary and secondary porosity and permeability that is collectively between 1,200 and 1,400 feet thick.

12. It is my opinion that there is no risk to freshwater resources from injection within the Wristen Group, Fusselman, and Upper Montoya Group because of the depth of these sub-formations and the upper shale permeability boundary created by the Woodford Shale, along with other shale-dominated units above the Woodford Shale.

13. I have also studied the location of known fault lines within the area where the well is proposed to be drilled and the closest known fault line is projected to be 1.2 miles away from the proposed well location.

14. There are no currently recognized production shales within the Wristen Group, Fusselman Formation, and Upper Montoya Group in this part of the western Permian Basin. While there may be some isolated traps located within these sub-formations, it takes significant ability with imaging to be able to locate these deposits in order to properly target them.

15. I attest that the information provided herein is correct and complete to the best of my knowledge and belief.

16. The granting of these applications is in the interests of conservation and the prevention of waste.

[Signature page follows]

Kate Zeigler

Kate Zeigler

SUBSCRIBED AND SWORN to before me this 11th day of November, 2019 by Kate Zeigler.

[Signature]

Notary Public

My commission expires: 8/1/2023

Age		Stratigraphic Unit		Key Feature	Estimated Depth Below Land Surface	
Triassic		Chinle		Freshwater resources		
		Santa Rosa				
Permian	Ochoan	Dewey Lake				
		Rustler				
		Salado				
		Castile				
	Guadalupian	Delaware Mtn. Grp.	Bell Canyon		<div>↑ Current petroleum zone ↓ ↑ Current petroleum zone ↓ ↑ Current petroleum zone ↓</div>	
			Cherry Canyon			
			Brushy Canyon			
	Bone Spring					
Leonardian	Wolfcamp					
Wolfcampian	Wolfcamp					
Pennsylvanian	Virgilian	Cisco				
	Missourian	Canyon				
	Des Moinesian	Strawn				
	Atokan	Atoka				
	Morrowan	Morrow				
Mississ.	Upper	Barnett				
	Lower	limestones				
Devon.	Upper	Woodford		Shale: permeability barrier	----- ~16,800'	
	Middle				----- ~17,000'	
	Lower	Thirtyone		Target injection interval		
Silur.	Upper	Wristen				
	Middle					
	Lower	Fusselman			----- ~18,000'	
Ordov.	Upper	Montoya		----- ~18,250'		
	Middle	Simpson		Shale: permeability barrier	----- ~18,600'	
	Lower	Ellenburger			----- ~19,500'	
Cambrian		Bliss				
Precambrian		basement				

Stratigraphic chart for the Delaware Basin from Broadhead (2017).

* Based on data from 30-025-41524 Cotton Draw 32 State 2 (32-24S-32E).