



RAILROAD COMMISSION OF TEXAS

HEARINGS DIVISION

OIL AND GAS DOCKET NO. 08-0309600

APPLICATION OF PROBITY SWD, LLC (679304) PURSUANT TO STATEWIDE RULE 9 FOR A COMMERCIAL PERMIT TO DISPOSE OF OIL AND GAS WASTE BY INJECTION INTO A POROUS FORMATION NOT PRODUCTIVE OF OIL OR GAS FOR THE HOSS 846 SWD LEASE, WELL NO. 1, LUTHER SE. (SILURIAN-DEVONIAN) FIELD, HOWARD COUNTY, TEXAS

HEARD BY: Karl Caldwell, P.E. – Technical Examiner
Kristi M. Reeve – Administrative Law Judge

APPEARANCES: **REPRESENTING:**

APPLICANT:

Jamie Nielson
James Clark
Matthew Schwab
Steve Montfort

Probity SWD, LLC

PROTESTANT:

Michael McElroy
Mark Belcher

Wagner Oil Company

OBSERVER:

John Hicks

Sabalo Energy LLC and Sabalo Operating, LLC

PROCEDURAL HISTORY

Application Filed:	December 12, 2017
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STATEMENT OF THE CASE

Pursuant to Statewide Rule 9 (16 Tex. Admin. Code § 3.9), Probity SWD, LLC ("Probity" or "Applicant") seeks a commercial permit to dispose of oil and gas waste by injection into a porous formation not productive of oil or gas, for the Hoss 846 SWD Lease, Well No. 1 ("Hoss 846 SWD"), Howard County, Texas. The proposed disposal well will be located on a 10-acre tract, about 14 miles northeast of Big Spring. Probity has a surface use agreement which, if granted a disposal permit by the Commission, would allow Probity to inject into a non-productive formation at the proposed well location. Probity seeks authority to dispose up to 25,000 barrels per day (bpd) of salt water and RCRA-exempt waste, into the Montoya and Ellenburger formations in the depth interval from 10,004 feet to 11,000 feet. The application is currently protested by nearby operator Wagner Oil Company ("Wagner"). Wagner's primary concern is the high potential for injected fluids to travel from the open-hole disposal interval up into the Fusselman formation where Wagner's wells are completed. Wagner notes that a poor cement bond across the Sylvan formation, a shale ("Sylvan shale"), between the disposal interval and the Fusselman formation, is common.

Upon review of the evidence in the record, the Administrative Law Judge and Technical Examiner (collectively, "Examiners") recommend approval of the application with the addition of two special permit conditions not already recommended to be met prior to commencing disposal operations: 1) the entire wellbore shall be cased; and 2) the operator shall run a cement bond log and submit the log to UIC prior to commencing disposal operations to ensure the cementing of the wellbore meets the requirements of Statewide Rule 13.

JURISDICTION¹

Sections 81.051 and 81.052 of the Texas Natural Resources Code provide the Commission with jurisdiction over all persons owning or engaged in drilling or operating oil or gas wells in Texas and the authority to adopt all necessary rules for governing and regulating persons and their operations under the jurisdiction of the Commission.

Section 27.031 of the Texas Water Code states that no person may continue using a disposal well or begin drilling a disposal well or converting an existing well into a disposal well to dispose of oil and gas waste without first obtaining a permit from the Commission.

¹ The hearing transcript in this case will be referred to as "Tr. pg., ln [page, lines]". Exhibits in this case will be referred to by the party's name and exhibit number.

APPLICABLE LAW

The Railroad Commission may grant an application for a disposal well permit under Texas Water Code § 27.051(b) and may issue a permit if it finds:

1. The use or installation of the injection well is in the public interest;
2. The use or installation of the injection well will not endanger or injure any oil, gas, or other mineral formation;
3. With proper safeguards, both ground and surface fresh water can be adequately protected from pollution; and
4. The applicant has made a satisfactory showing of financial responsibility as required by Section 27.073.

Additionally, the applicant must comply with the Commission's Statewide Rules.

DISCUSSION OF THE EVIDENCE

APPLICANT'S EVIDENCE

James Clark, P.E., consulting engineer for the Applicant and Matthew Schwab, Chief Operations Officer for Probity SWD, LLC, provided testimony and evidence for Probity.

Application

The current Form W-14, *Application to Dispose of Oil and Gas Waste by Injection into a Formation Not Productive of Oil and Gas*, indicates the proposed Hoss 846 SWD Lease, Well No. 1 ("Hoss 846 SWD") will be located on a 10-acre tract, about 14 miles northeast of Big Spring.² Probity has a surface use agreement which, if granted a disposal permit by the Commission, would allow Probity to inject into a non-productive formation at the proposed well location. On-cross examination, Matthew Schwab, Chief Operations Officer for Probity Saltwater Disposal, testified "The Manley Energy Assets lease has been assigned to Probity."³

The proposed well location listed on the current Form W-14 is approximately 300 to 400 feet from the well location Probity initially listed on the previously-filed Form W-14. The original well location was protested by Sabalo Operating, LLC ("Sabalo") and Wagner Oil Company ("Wagner"). James Clark, P.E. testified,

² Probity Exhibit No. 3.

³ Tr. pg. 74, ln 20 – pg. 75, ln 4.

"We initially picked out an application (a location) and two parties protested it, Sabalo, who was concerned about collisions with their Wolfcamp horizontal wells, and then Wagner who's here today. And we came to an agreement with Sabalo by moving the location. So that is why we moved the location to the east. And along with that movement of the location, I essentially had to submit a new application, and it's the application that's – that we're here for today."⁴

Notice of the application was provided to the owner of the surface tract on which the proposed disposal well will be located, to owners of adjacent surface tracts, to all operators within a half-mile radius of the proposed well location (Sabalo and Wagner), and to the Howard County Clerk. On May 30, 2018, notice of the application was published in the *Big Spring Herald*, a newspaper of general circulation in Howard County. The current application is protested by Wagner.

Mr. Clark asserts that Probity approached him to evaluate potential disposal zones deeper than the Wolfcamp formation ("Wolfcamp") because Probity's clients were drilling horizontal wells in the Wolfcamp and want to inject into a formation deeper than the Wolfcamp, "because the San Andres formation is getting overpressured."⁵ As a result, Mr. Clark investigated which interval below the base of the Wolfcamp would be viable for disposal, and determined the Ellenburger formation. Mr. Clark then proceeded to devise a wellbore design for that particular well location. Mr. Clark asserted that he did not play a role in determining the well location and stated, "They (Probity) picked it and I told them I will look and see if there are any issues, such as improperly plugged wells within an AOR, any seismic issues, things like that. But, no, I did not pick the initial location. I just -- I okayed it."⁶

Injection interval

The proposed Hoss 846 SWD has not yet been drilled.⁷ The Form W-14 lists the proposed disposal interval as the depth interval from 10,004 feet to 11,000 feet within the Montoya and Ellenburger formations. The Montoya and Ellenburger formations are not productive in this area. The requested maximum injection volume is 25,000 barrels per day ("bpd") of salt water and RCRA-exempt waste, at a maximum surface injection pressure of 5,002 pressure per square inch, gauge ("psig"). Mr. Clark estimates that the base of the Ellenburger formation to be at a depth of 11,100 feet, but will not know for sure until the well is drilled and logged.⁸ The draft permit includes special conditions that injection shall be no deeper than 100 feet above the estimated base of the Ellenburger formation as determined by the RRC using the log and/or the estimated Ellenburger thickness at the well location. The draft permit also includes a provision that the operator shall provide an electric log, and if available, a mud log, to the UIC.

⁴ Tr. pg. 14, ln 20 – pg. 15, ln 4.

⁵ Tr. pg. 77, ln 11-12.

⁶ *Id.* ln 21-25.

⁷ Tr. pg. 15, ln 19.

⁸ Tr. pg. 95, ln 20-24.

Geological Requirements

A groundwater protection letter from the Groundwater Advisory Unit ("GAU") of the Oil and Gas Division for the subject well states:

"To protect usable-quality groundwater at this location, the Groundwater Advisory Unit of the Railroad Commission of Texas recommends the interval from the land surface to a depth of 300 feet must be protected. The GAU estimates the base of underground sources of drinking water (USDW) is estimated to occur at a depth of 1,300 feet at the site of the referenced well."⁹

In addition, a letter from the Oil and Gas Division, dated June 5, 2018 states:

"A review of the data contained in the application and of other geologic data indicates, if otherwise compliant with Railroad Commission of Texas rules and guidelines, that drilling and using this disposal well and injecting oil and gas waste into the subsurface stratum in the depth intervals from 10,004 to 11,000 feet will not endanger the freshwater strata in that area. The base of usable-quality groundwater occurs to a depth of approximately 300 feet in accordance with GAU Letter No. 198665. The base of the USDW is estimated to be 1,300 feet. Geologic isolation from the BUQW and the USDW is at 1,750 feet."¹⁰

The Form W-14 lists the productive formations within two miles of the proposed well location as the Clearfork, Spraberry, Dean, Wolfcamp, Silurian, Devonian, and Fusselman formations, at depths from 6,300 feet to 9,982 feet. The proposed injection interval into the non-productive Montoya and Ellenburger formations between 10,004 feet and 11,000 feet is deeper than all of the productive formations within two-miles of the proposed well location.

Confinement of Fluids Injected to the Disposal Interval

A well log for a nearby well, the S.E. Luther No. 19-4, API No. 42-227-32550, ("SELF 1904") shows the depth to the top of the Montoya and Ellenburger disposal interval is roughly 9,950 feet. Mr. Clark estimates the SELF 1904 well to be somewhere between a few hundred feet to a thousand feet from the location of the proposed Hoss 846 SWD. Mr. Clark asserts that the Sylvan shale is the interval that will confine injected fluids to the requested Montoya and Ellenburger disposal interval. Mr. Clark estimates the depth to the top of the Sylvan shale to be a little shallower than 9,900 feet, and the thickness of the Sylvan shale confining interval that caps the top of the injection interval to be roughly 50 feet and maybe up to 70 feet.¹¹

⁹ Probity Exhibit No. 5.

¹⁰ Probity Exhibit No. 6.

¹¹ Tr. pg. 97, ln 13 - pg. 98, ln 11.

Using the same SELF 1904 well log, Mr. Clark represents that the productive Fusselman formation is at a depth interval from 9,850 feet to 9,900 feet, and is the zone that is being waterflooded by Wagner. Mr. Clark represents that the Woodford Shale formation is above the Fusselman formation, and the Woodford shale formation extends from a depth of about 9,780 feet to 9,845 feet. Further up-hole is additional impermeable strata, including the Wolfcamp formation, at a depth from roughly 7,410 feet to at least 7,900 feet. Mr. Clark maintains the Wolfcamp formation is a shale interval that is more than 250 feet thick of cumulative shale thickness and more than a hundred feet of continuous thickness between the top of the injection zone and the BUQW.¹²

Mr. Clark asserts that the Sylvan shale between the proposed disposal interval and the productive Fusselman formation is regionally present in the area. Mr. Clark claims the Tate D 3 (API No. 42-227-38574) is a disposal well located approximately 3.5 miles to the south of the proposed Hoss 846 location that is injecting into the Ellenburger formation. Mr. Clark constructed a three-well cross section that included the SELF 1904 well log and the Tate D 3 and stated:

"What you see here on all wells, the Sylvan shale is present -- in fact, I would say it's present regionally -- as is the Montoya/Ellenburger disposal zone on top of (in addition to) the Sylvan shale. The Fusselman is present in all of these wells over a fairly large area. And then above the Fusselman, the Woodford Shale is present, too. So these barriers are continuous laterally over a large area, in particular the Sylvan shale which is the confining shale interval, the interval that will confine the production to the Montoya and Ellenburger zones."¹³

The Southeast Luther (Silurian-Devonian) Field ("Field") is the Commission-designated field name for the productive Fusselman formation that overlies the Sylvan shale and is where Wagner's wells are completed in this area. In Special Order No. 8-32,020, Adopting Rules and Regulations for the Southeast Luther (Silurian-Devonian) Field, Howard County, Texas, the Special Order states that from evidence adduced at said hearings and from sworn records and reports subsequently filed... *That the porous zone is overlain and underlain by dense impermeable non-productive limestone.* Mr. Clark asserts "I feel like that dense limestone and that shale will be very effective barriers to prevent water-injected water into the Montoya/Ellenburger interval from making it up into the Fusselman."¹⁴

In reciting testimony from a 1955 field rule hearing, Mr. Clark stated (*as read*):

"As illustrated on Exhibit 2, the Fusselman Formation is overlain and underlain by impermeable shale, which the order said impermeable, dense limestone, but I'll clarify that. And if you go to the final page of this exhibit, what's been highlighted describes it a little better, as well, the next cross section visually. It's describing the Fusselman that (is) being waterflooded,

¹² Tr. pg. 33, ln 11-20.

¹³ Tr. pg. 35, ln 2-13.

¹⁴ Tr. pg. 37, ln 11-15.

and it says, (as read) *The porous productive zone is underlain by a dense, nonproductive limestone member, usually from five to 10 feet thick. Impermeable shale underlies the Fusselman. The occurrence in shale and dense limestone above and below the porous Fusselman zone is illustrated on cross section A-A', Exhibit 2, which is our next exhibit. (As read) The occurrence of these underlying dense limestone and shale members is continuous and serves as effective barriers so as to negate -- so as to negate the possibility of any bottom water drive. I think that means negate.... So I do believe that that Sylvan shale is an adequate barrier between the top of our injection interval and the Fusselman that's being waterflooded as stated in the order.*"¹⁵

Mr. Clark contends that one of the wells used in the cross-section in the 1955 field rule hearing, the discovery well, the Spencer "A" No. 1 is in the same section that the proposed Hoss 846 SWD is proposed to be drilled. The Spencer well is in the northern part of Section 14, and the proposed Hoss 846 SWD well is in the southern part of Section 14. Mr. Clark estimates the distance between the two well locations is about 4,500 feet.¹⁶

Mr. Clark notes that in an Examiners' Report in Oil and Gas Docket No. 08-0288586, an application to dispose of acid gas into the Montoya and Ellenburger formations in Howard County, the applicant, ConocoPhillips Company relied on the same Sylvan shale as the barrier to prevent upward migration out of the injection zone. Mr. Clark asserts the Commission found that the Sylvan shale was an adequate barrier to upward migration. Mr. Clark estimated the well in Oil and Gas Docket No. 08-0288586 is located 15 to 20 miles from the subject well.¹⁷

On cross-examination, Mr. Clark acknowledged that in Oil and Gas Docket No. 08-0288586, Finding of Fact No. 13, states *applicant's proposed injection interval is limited to the Sylvan shale, Montoya, and Ellenburger formations*. However, Mr. Clark asserts that is not accurate and the injection interval does not include the Sylvan shale. Mr. Clark contends that is an error for the following reasons:

"(A) it's a shale. And then (B) flip to the next page and read Finding of Fact 15. (*The Sylvan shale formation is impermeable at the well's location and provides adequate confinement of disposal fluids to the well's proposed injection interval*). They're in direct conflict with each other. And everything I saw from that docket indicated that the injection was to be into the Montoya and Ellenburger."¹⁸

On cross examination, Mr. Clark asserts that a reasonable estimate of the current bottomhole pressure of the Montoya/Ellenburger disposal interval is that it is normally pressured. Mr. Clark maintains a normally pressured reservoir in this area would generally be 0.465 psi per foot, multiplying by the depth of roughly 10,000 feet would be

¹⁵ Tr. pg. 38, ln 4- pg. 40, ln 6.

¹⁶ Tr. pg. 40, ln 10-15.

¹⁷ Tr. pg. 42, ln 18-22.

¹⁸ Tr. pg. 96, ln 13-17.

roughly 4,500 psi bottomhole pressure at the top of the proposed disposal interval at a depth of 10,004 feet. Mr. Clark stated:

Q And did you evaluate the risk that the injection into the Ellenburger/Montoya might frac up into the Fusselman formation that Wagner is waterflooding?

A Yes.

A All right. Well, what did you do to evaluate that risk?

A Well, I looked at the confining layers, and I know we're absolutely prohibited from injecting above formation fracture pressure.

Q Okay. Is that the extent of the study?

A Yes.

Q And can you confidently conclude that there will be no cross flow from the normal pressured Ellenburger 4500 pounds to the depleted Fusselman formation that Wagner is waterflooding?

A Well, (a), I don't know what the current pressure is in the Fusselman. But, yes, I do believe the Sylvan shale and the basal Fusselman that is dense -- a dense limestone provides an adequate barrier for cross flow.

Q You reached that conclusion without knowing the Fusselman bottom hole pressure. Correct?

A That's correct. It's a barrier regardless of the pressure in the Fusselman.

Q Do you have any idea if cross flow does occur and injection into the Ellenburger breaks into the Fusselman, how much oil would potentially be lost in the secondary recovery project in the Fusselman?

A I saw Wagner's estimate of that, I think, in one of your cover letters.

Q Do you have an estimate of how much -- how much oil would be lost?

A No, because I don't believe that's going to happen.

Q You reached that conclusion, though, without studying the difference in pressures between the two formations?

A Correct. There's a confining layer between the top of the injection interval and the Fusselman. So I don't see cross flow occurring due to that confining interval.

Q When injection wells or disposal wells -- as in this case -- when a disposal well is initially completed, is there any Railroad Commission rule that prohibits the operator from fracture stimulating the proposed disposal well?

A I don't believe there's a rule that prevents it.

Q And in your experience, are you saying that fractures, for example, in the Fusselman -- I mean, in the Ellenburger would absolutely never expand vertically into the Fusselman? You're saying that's impossible?

A I'm not saying it's impossible. I don't believe it's going to happen. I mean, they're not -- the permit is to confine injection to the Montoya and Ellenburger. And if they can't do that, they don't have a valid permit.

Q But that may not be -- the fact that it's not confined might not be determined until after the damage has occurred. Isn't that correct?

A I guess so. I just don't see how -- I don't see how they're going to frac up into the Fusselman through an Ellenburger disposal well at this location.¹⁹

Proposed Well Construction Plan

The proposed well construction plan is to set 13-3/8 inch surface casing to a depth of 375 feet and circulate cement to surface to protect the BUQW, which occurs from surface to a depth of 300 feet. Then, Probity proposes to set 9-5/8-inch intermediate casing at a depth of 5,100 feet with a DV tool at a depth 3,000 feet for a two-stage cement job for this string of casing. Next, 7-inch long string casing will be set at the top of the disposal interval at about 10,004 feet, a depth based on an offset log, and the casing will be cemented with a top of cement (TOC) at about 4,600 feet, which would be about 500 feet above the immediate casing shoe. Lastly, the well will be drilled through the Montoya formation and through the majority of the Ellenburger formation, for an open hole disposal interval from 10,004 feet to 11,000 feet.

Mr. Clark was asked if he could recall any disposal wells with an open-hole disposal interval that had been granted pursuant to Statewide Rule 9 since Statewide Rules 9 and 46 had been updated. Mr. Clark stated:

A Not off the top of my head. Not off the top of my head.

Q Okay.

A I don't think Probity would really object to running casing into the Ellenburger and cementing it from there either.²⁰

¹⁹ Tr. pg. 91, ln 4 – pg. 94, ln 2.

²⁰ Tr. pg. 102, ln 8-13.

On cross-examination, Mr. Clark stated that if the Fusselman interval is depleted to a point where it is significantly under-pressured, it is possible for that zone to be a potential lost circulation zone when the proposed Hoss 846 SWD well is drilled.²¹ However, Mr. Clark clarified by stating, "Well, just being under pressure doesn't necessarily mean it's gonna be a lost circulation zone. I mean, you're still gonna be able to drill. You may have -- you have lost circulation materials; you have your mud building up a cake on the borehole between the limestone. So just being under pressure does not necessarily -- does not necessarily mean you're going to experience lost circulation."²²

On subsequent cross-examination, Mr. Clark asserts that if there was any lost circulation when drilling the proposed disposal well, drilling mud probably would not penetrate the formation very far from the wellbore because you can control loss circulation by adding loss circulation materials to the drilling mud. Therefore, if Probity were to encounter lost circulation when drilling the proposed disposal well through the Fusselman formation, it would not necessarily result in damage to the productive capability of the Fusselman formation.²³

Area of Review

There is one producing well, three plugged and abandoned wellbores (P&A'd), one of which was a dry hole, and five permitted well locations within a quarter-mile area of review around the proposed location of the Hoss 846 SWD. The producing well is operated by Sabalo and completed in the Field, producing from the Fusselman formation. Sabalo is also the operator of the five permitted well locations targeting the Wolfcamp formation. Mr. Clark represents that all of the P&A'd wells are properly plugged and will not act as conduits for fluid to escape the injection zone based on a review of the plugging records for the P&A'd wells.

On cross-examination, Mr. Clark stated that he only included plugging information for one of the P&A'd wells as an exhibit, which was the only well which did not show an API number on the quarter-mile area of review map. This well is the C.M. Weaver, et. al. No. 1, referred to as Map Code C. Mr. Clark testified, "You see no API by it, and that particular plugging report is not available online. So I made it readily available to the permit reviewer."²⁴ Mr. Clark asserts "I don't normally attach modern completion reports -- I mean, plugging reports from wells that have API numbers and were plugged recently enough to where they can be viewed online."²⁵

²¹ Tr. pg. 103, ln 9-16.

²² Tr. pg. 103, ln 21-pg. 104, ln 3.

²³ Tr. pg. 104, ln 16-pg. 105, ln 18.

²⁴ Tr. pg. 88, ln 8-10.

²⁵ *Id.* ln 2-6.

Oil and Gas Activity in the Area***Existing Commercial Disposal Wells in the Area***

Matthew Schwab, Chief Operations Officer for Probity Saltwater Disposal, is responsible for the general overall operations, and is involved in determining where to construct saltwater disposal wells. Probity currently operate 8 disposal wells, with a ninth recently drilled. Mr. Schwab contends that Probity relies on input from its customers to determine customers' needs and where new disposal services are required.²⁶

There are currently nine commercial disposal wells permitted within a 5-mile radius of the proposed Hoss 846 SWD. Of the nine commercial disposal well permits issued, six are active wells, while three are permitted wells but the disposal well has not yet been drilled. The six active commercial disposal wells are permitted for a cumulative injection volume of 108,000 bpd, while the three permitted, but not yet drilled wells, are permitted for a cumulative injection volume of 60,000 bpd.

Probity currently operates one of the six active commercial disposal wells within a 5-mile radius of the subject application. Mr. Schwab represents that Probity's active commercial disposal well is currently shut down for a cleanout and replacement of a gun barrel at the facility. When operational, Mr. Schwab asserts that the facility had been injecting between 23,000 to 27,000 bpd before being shut down for maintenance, and the well is permitted to inject a maximum of 30,000 bpd.

Mr. Schwab contends that Probity is pursuing this commercial disposal well permit at this location based on customer need. Mr. Schwab testified, "We've been asked by several operators to expand our service offering in Howard County. That's why we are pursuing this location..."²⁷ Mr. Schwab maintains that when Probity plans a saltwater disposal facility, it works with customers on their future needs and where operators are expanding operations to try and get ahead of development, so infrastructure is in place when operators go to drill and produce wells. Mr. Schwab represents that in the Howard County area, a two mile long horizontal well may produce between 1,500 to 4,100 barrels of water per day ("bwpd") on initial flowback.²⁸ Mr. Schwab testified:

"I mean, when you look at what our current customers' plans are going forward, the amount of wells they want to drill in an area -- I mean, you look at just sheer -- those volumes off the type curve; I mean, two, three well pads can occupy an entire 25,000 barrel-a-day permitted disposal well by producing that volume on their initial production. So, you know, I have a permit count in Howard County in general, but it's -- obviously they're putting a substantial amount of wells in that area that are horizontals with two-mile laterals; you're looking at substantial need for disposal."²⁹

²⁶ Tr. pg. 64, ln 3-17.

²⁷ Tr. pg. 64, ln 3-6.

²⁸ Tr. pg. 64, ln 21 – pg. 65, ln 3.

²⁹ Tr. pg. 65, ln 10-21.

Mr. Schwab alleges the presence of the proposed Hoss 846 SWD well will reduce water hauling costs in the area around the proposed well location. Adding a new disposal well location will shorten the water hauling time by truck, and reduce operational costs for operators. Mr. Schwab represents that Probity has plans to use piping rather than trucking for transporting water, and is designing a system in Howard County to connect its existing disposal facilities in the county with its new disposal well applications in Howard County. Mr. Schwab testified "We do have plans to put a pipeline that connects all these wells together so we can utilize the entire, you know, strength of our system and capacity of water."³⁰

The proposed disposal interval is the non-productive Montoya and Ellenberger formations. Mr. Schwab claims operators in Howard County have a preference to not inject into the San Andres formation to avoid pressuring up the San Andres formation and operators have a preference to dispose into deeper formations below the productive formations in the area. Mr. Schwab stated, "you know, typical in the Midland Basin specifically, you know, talking Howard County, the San Andres formation is getting pressured up in operators' opinions, and so they prefer us not to inject and would prefer us to be under their production, you know, not in the San Andres well but injecting where it's not gonna affect their operations."³¹

Financial Assurance

At the time of the hearing, Probity (Operator No. 679304), had an active P-5 organization report and a \$50,000 cash deposit as financial assurance.

Additional Information

A review of the records of the U. S. Geologic Survey indicated there were no seismic events with a magnitude of 2.0 or greater within a 9.08 kilometer radius (100 square miles) of the proposed disposal well between January 1, 1973 and June 7, 2018.³²

PROTESTANT'S EVIDENCE

Wagner's primary concern is the potential for water to migrate from the open-hole disposal interval up into the low-pressure Fusselman oil producing zone due to channeling behind casing due to a poor cement bond across the Sylvan shale. A poor cement bond across the Sylvan shale is common.³³ Mark Belcher, Vice President of Engineering for Wagner Oil Company, supervises the reservoir group, the operations group, and the geoscience teams for Wagner. Mr. Belcher stated Wagner's other concerns with Probity's application are as follows:

"Our key considerations are, first of all, the proposed location is within the limits of the Fusselman porosity in our unit. It's also likely that the

³⁰ Tr. pg. 67, ln 2-5.

³¹ Tr. pg. 70, ln 11 – 17.

³² Probity Exhibit No. 12.

³³ Wagner Exhibit No. 5.

Montoya/Ellenburger is fractured. And these are very hard carbonate formations, brittle, often fractured, particularly at the top of the formation where the injection is likely to go. As we demonstrated here and we'll demonstrate more later, it's very common, almost always, there's poor bond across the Sylvan shale. And the Sylvan shale is a -- what we call a brittle, fissile shale. And, you know, not all shales are created equal. The Sylvan has some carbonate constituents to it, some dolomitization. Sometimes our lithology track on the log on the left illustrates that. This gray area here shows a shale that is different than, say, the Woodford Shale. The Woodford Shale is above the Fusselman. That creates our seal in the trap. This is more ductile plastic shale. It's part of the reason this reservoir is here. It's the top seal, and then there's a pinch-out to the east. But again, the Probity location is within this pinch-out. The Sylvan shale is brittle, not truly a clay shale, not all of it. There's some clay components, but it can be broken. It's cleavable, and we have some core data later to demonstrate that.."³⁴

Other key considerations, listed on Wagner Exhibit No. 5 are as follows:

1. Proposed location is within Fusselman porosity at an up-dip location.
2. Montoya/Ellenburger likely fractured.
3. Poor cement bond often exhibited across Sylvan shale.
4. Sylvan shale is a brittle/fissile shale.
5. One of the few frac attempts in the Fusselman broke down into the Sylvan.
6. High likelihood of poor casing shoe test.³⁵
7. High injection rates and pressure proposed by Probity will likely break down the cement at the casing shoe, if any, and channel disposed waters (of unknown composition) up into the Fusselman oil production zone.

Probity's Proposed Disposal Well Location

Mr. Belcher maintains that the Field was discovered in 1954 and there were 44 wells drilled between 1954 and 1964. The unitization process in the Field began in 1967, and waterflood operations began in the field in 1969. Wagner currently operates 17 wells in the Field. Mr. Belcher asserts that Wagner has 10 saltwater injection wells, and both

³⁴ Tr. pg. 116, ln 12 – pg. 117, ln 11.

³⁵ A casing shoe test is a test performed after a casing string has been set. The test is conducted on the formation directly below the casing shoe to determine the formation breakdown pressure to aid in designing the mud program for drilling the underlying formation.

the injection wells and the producing wells in the Fusselman zone of the Field currently make about 360 barrels a day and is one of the top value fields for Wagner.

One of Wagner's concerns with Probit's application is that the location of the proposed Hoss 846 SWD well is within the boundary of Wagner's Unit, and drilling the well would require penetrating the Field interval where Mr. Belcher asserts there is Fusselman porosity. Mr. Belcher contends that there are other commercial disposal wells in the area, for example, the Velocity-Hughes SWD. The Velocity-Hughes SWD is a disposal well using the San Andres formation as a disposal interval, and is located approximately 1.2 miles from the proposed Hoss 846 SWD. Mr. Belcher asserts that the Velocity-Hughes SWD is located outside of the Fusselman porosity of the Field and outside the boundaries of Wagner's Unit.³⁶

Mr. Belcher represents that the Field is an elongated carbonate wedge with a monoclinial dip to the west while the eastern side of the Field exhibits a porosity pinch-out. Mr. Belcher stated, "The Fusselman pinches out and disappears on the up-dip edge of the Field again on the east side. And we see the Probit proposed location right here, right inside the porosity pinch-out."³⁷ Mr. Belcher contends that the porosity pinch-out was described in the original unitization hearings conducted for the Field, and there is now some well control, including some dry holes where there is no Fusselman, and therefore, no Fusselman porosity, to identify the extent of the pinch-out. Mr. Belcher asserts that if Probit moved its well a little bit over to the east, it would be out of the Field altogether. Mr. Belcher stated "we feel like a lot of the remaining oil is likely to be up structure where the Probit location is. Any breakthrough in there could contaminate that oil and could push it around."³⁸

Mr. Belcher claims that there's significant risk of harm to those recoverable reserves if this well were to be permitted and drilled. On cross examination: Mr. Belcher asserts that the proposed disposal well would penetrate five to six feet of Fusselman porosity on Wagner's Unit at the proposed disposal well location.³⁹

Wagner's closest well to the proposed Hoss 846 SWD that penetrated the Montoya and/or Ellenburger formation is the Self 1401, located about 4,399 feet (0.83 miles) to the north-northwest.⁴⁰ Mr. Belcher does not know the distance of the nearest injector well or producer well on its Unit to the proposed Hoss 846 SWD and stated that it's not a pattern waterflood anymore, so there's some randomness.⁴¹

A Review of Cement Bond Logs (CBL)

A total of 52 wells have been completed in the Field, with the most recently completed wells being in 2005. Of the 52 wells completed in the Field, 13 penetrated at least the top of the Montoya/Ellenburger. Mr. Belcher claims that of the 52 wells

³⁶ Tr. pg. 114, ln 4 - 10.

³⁷ Tr. Pg. pg. 120, ln 4-7.

³⁸ Tr. Pg. 121, ln 17-20.

³⁹ Tr. pg. 163, ln 2-3.

⁴⁰ Tr. pg. 169, ln 15-23., Wagner Exhibit No. 12.

⁴¹ Tr. pg. 172, ln 3-6.

completed in the Field, 25 have had casing leaks over the life of the wells, and seven of those had DV tools as Probity has proposed in the construction of its well, which indicates to Mr. Belcher that DV tools are no assurance that there will not be casing problems.⁴²

Mr. Belcher analyzed cement bond logs for four of the most recent wells drilled in the Field: the Self Unit, Well Nos. 1003, 502, 603, and 902. Mr. Belcher analyzed both a zero pressure pass and a 1,000 psi pressure pass for each of the Self Unit, Well Nos. 1003, 502, 603, and 902. Mr. Belcher describes the 1,000 psi pressure pass as a pass with the CBL tool while a thousand psi pressure was being held on the casing which allows the casing to balloon and expand against any cement that might be there, indicating a more optimistic indication of cement bond.⁴³

The Self Unit, Well Nos. 1003, 502, 603, and 902 were drilled by Chesapeake in 2005. Mr. Belcher claims that the wells drilled by Chesapeake in 2005 utilized recent cementing techniques which were state-of-the-art, which have not changed much since that time for cementing vertical wells. In addition, Mr. Belcher asserts that the cement bond log technology had advanced at that point to be reliable.

Mr. Belcher contends that it is significant to note that these four wells were drilled with formation pressures that were similar, if not slightly higher, than the current reservoir pressures. Mr. Belcher asserts that there was a level of depletion in the Fusselman formation at the time these wells were drilled. Mr. Belcher stated, "Depletion can cause -- and we somewhat alluded to earlier -- if some of the drilling fluids go into the formation or even the cement filtrate goes into the formation, it can make it difficult to get good bond, get a good solid cement sheath around the casing."⁴⁴ This may adversely affect the wellbore result in the lack of cement isolation between the Fusselman and the Ellenburger formations, which is reflected by the cement bond logs.

For the Self Unit, Well No. 1003, a CBL from March 17, 2005, does not penetrate into the Montoya/Ellenburger disposal interval. Mr. Belcher asserts that the important thing to note from the 1,000 psi pressure pass is the CBL indicates a very poor bond below the top of the Sylvan shale and across the Sylvan shale interval.⁴⁵ This well did not penetrate into the Montoya/Ellenburger formations. The zero pressure pass for the same well with no pressure applied to the casing on that CBL run indicates to Mr. Belcher that there is no cement bond across the Sylvan shale interval for this well.

Mr. Belcher acknowledged that the bond log data is important to its assertions in this case. Mr. Belcher considers the cement bond log (CBL) for the Self 10-3 in the Unit, a well that was drilled by Chesapeake in 2005, to be a modern log. Mr. Belcher asserts that the CBL for this well shows very little cement bond across the Sylvan shale, and no cement bonding below the Fusselman.⁴⁶ Belcher also analyzed a 1,000 psi pressure pass CBL for this well, which Mr. Belcher described as the most optimistic depiction of cement bond. Mr. Belcher stated, "In other words, if you pressure up on the casing and

⁴² Tr. pg. 123, ln 4-5.

⁴³ Tr. pg. 115, ln 19 - pg. 116, ln 1.

⁴⁴ Tr. pg. 125, ln 13-17.

⁴⁵ Tr. pg. 131, ln 20 - pg. 132, ln 17.

⁴⁶ Tr. pg. 114, ln 16 - pg. 116, ln 10.

there's still lack of indication of cement bond, it's an indication of channeling or just very poor cement or perhaps no cement at all to speak of."⁴⁷

A CBL was run on the Self Unit, Well No. 502 on August 31, 2005. Mr. Belcher stated, "The next cement bond log in 13 is a log running the Self 502 on August 31st of 2005. This log was run on a thousand pounds held on the casing. This log shows very poor to scattered bond, even at the top of the Montoya/Ellenburger; poor bond across the Sylvan, minimal bond at the very top of the Sylvan."⁴⁸ Based on the cement bond log results, Mr. Belcher claims the poor cement bond in this well has the potential to channel water from the Montoya/Ellenburger, up to the Fusselman.⁴⁹ The zero pressure pass, conducted on August 31, 2005 also indicated poor bond across most of the Sylvan shale, and poor bond at the top of the Montoya/Ellenburger.

The CBL for the Self Unit, Well No. 603, was run on May 12, 2005. For the 1,000 psi pressure pass CBL, Mr. Belcher stated "What's noteworthy about this lot is the poor bond in the Montoya/Ellenburger itself, from the top of it... But it is very important to note that Montoya/Ellenburger poor bond. And it has a pressure pass, a thousand pounds."⁵⁰ For the zero pressure pass, Mr. Belcher stated "Then we see virtually no bond in the Montoya/Ellenburger. We see the same lack of bond across the Sylvan. There's a little bit of difference in these passes. They're both poor, the pressure pass and non-pressure pass. But the difference is often indicating of a micro channels behind pipe."⁵¹

The CBL for the Self Unit, Well No. 902, was run on June 4, 2005. For the 1,000 psi pressure pass CBL, Mr. Belcher stated, "You see little bond -- no bond virtually in the top of the Montoya/Ellenburger, poor bonding across the Sylvan, pretty poor bonding in both of the Sylvan up into the Fusselman."⁵² For the zero pressure pass, Mr. Belcher asserts the CBL shows poor to no cement bonding from the top of the Montoya/Ellenburger through the Sylvan up to the Fusselman.

In summary, Mr. Belcher stated, "The significance of the poor bonding is seen even in the middle two thousands (2005) is the nature of the Sylvan shale to probably fracture, to ingest cementing fluids, to have permeability streaks in it, probably. It is rare to get good cement bond across the Sylvan shale."⁵³ Mr. Belcher also stated, "I think it would be very difficult to get cement as high as the Probity permit describes. The Sylvan shale and perhaps the Ellenburger itself is likely to be fractured. It's gonna be difficult to get -- to get cement where you need it. I think this could be a risky well to drill mechanically."⁵⁴

When asked if the same operator drilled and cemented the wells for which the cement bond logs show poor cement bonding to the casing, channeling, or no cement, Mr. Belcher stated, "They were all the same operator. It was Chesapeake Energy in this

⁴⁷ Tr. pg. 115, ln 22 – pg. 116, ln 1.

⁴⁸ Tr.pg. 133, ln 8-13.

⁴⁹ *Id.* 17-21.

⁵⁰ Tr. pg. 134, ln 17-24.

⁵¹ Tr. pg. 135, ln 10-15.

⁵² Tr. pg. 135, ln 22-25.

⁵³ Tr. pg. 136, ln 19-24.

⁵⁴ Tr. pg. 137, ln 5-10.

case.”⁵⁵ Mr. Belcher is not aware of any evidence that Chesapeake changed their cement blends or well conditioning program.⁵⁶

Sylvan Shale Characteristics

Mr. Belcher prepared a three-well cross section that runs west-to-east on the eastern edge of Wagner's Unit that intersects the location of the proposed Probity disposal well. Mr. Belcher claims “the Probity well will penetrate the Fusselman in the porosity zone within our allotted flooding unit. You can see approximately 150 feet from the base of the Fusselman porosity to the casing shoe in the proposed wellbore construction of the Hoss 846 SWD. So there's no more than 85 feet of Sylvan shale between the bottom of our perforated interval and the casing chute (shoe) and Probity's proposed well.”⁵⁷

In addition, Mr. Belcher prepared a three-well cross section that runs approximately parallel to the eastern edge of Wagner's Unit, intersecting the location of the proposed Hoss 846 SWD. The Self 1401 well, located approximately 4,399 feet from the proposed Hoss 846 SWD location, penetrates the top of the Montoya/Ellenburger intervals, and the well log also shows the Sylvan shale as well as the Fusselman and the Woodford shale intervals. Mr. Belcher contends that the Self 1401 well log shows a more pronounced gamma ray reading in the Woodford shale formation than in the Sylvan shale, indicating that the Sylvan shale has some components that are not radioactive, such as more sand, and more dolomite. Mr. Belcher claims the Sylvan shale is more brittle than the Woodford shale formation and is “more likely to fracture; and is “more likely to drink cement for lack of a better phrase.”⁵⁸

Mr. Belcher notes that the Self Unit 1401, Self Unit 2303, and Self Unit 2603 well logs show the intervals perforated in these wells and that virtually all of the Fusselman zone is perforated, even the lower Fusselman that Probity considers to be tight. In addition, the well logs indicate that the Sylvan shale is consistently about 50 feet thick along this cross-section.⁵⁹

Core Sample

A 56-foot core sample taken from the Southeast Luther Unit 26-2, included the bottom 27.6 feet of the Fusselman formation of the Field, and the top 28.4 feet of the Sylvan shale. The core description stated: 28.4 feet shale, black to dark gray, waxy, fissile. Mr. Belcher stated, “Fissile is a term used to describe brittle shales. They tend to cleave and fracture as opposed to, say, the Woodford Shale above the Fusselman zone.”⁶⁰

⁵⁵ Tr. pg. 170, ln 10-11.

⁵⁶ *Id.* ln 12-15.

⁵⁷ Tr. pg. 126, ln 21- pg. 127, ln 4.

⁵⁸ Tr. pg. 129, ln 3-4.

⁵⁹ Tr. pg. 129, ln 12-13.

⁶⁰ Tr. pg. 138, ln 3-6.

Self 1904 History of Injection Profile Issues

The Self 1904 is a plugged well located about 1,062 feet from the proposed Hoss 846 SWD. The Self 1904 well was drilled as a replacement well for the Self 1902. Water injection commenced in the Self 1904 in December of 1981. In 1983, about two years after injection operations commenced in the well, an injection profile indicated a channel and water channeling down to 9,907 behind the casing. A cement squeeze job was performed to squeeze off that channel and injection re-commenced. An injection profile after the cement squeeze indicated channeling down to 9,914 feet. Increased injectivity in January 1984 indicated the channel had enlarged, and that point was cement squeezed again and was successfully repaired. The well was acidized in January 1985 to enhance injection and injectivity continued to increase after the acid job was performed. An injection profile run in August of 1985 again showed channeling below the Fusselman formation. Injection profiles in December of 1992 and January of 1993 also indicated channeling behind the casing. Injection into the well ceased in January 2006, and the well was plugged and abandoned in December of 2015. Based on the tracer survey results, Mr. Belcher stated, "This is an illustration of what our contention is, but a really poor bond is not uncommon, almost expected, across the Sylvan shale."⁶¹ Mr. Belcher maintains that the tracer survey results show communication behind pipe down into to the Sylvan shale.⁶²

Mr. Belcher asserts Probitry will have problems isolating the Fusselman formation from deeper formations in drilling and cementing the proposed Hoss 846 SWD well. Mr. Belcher stated, "I think that because there's gonna be a very high probability of communication behind pipe or perhaps through the zone itself through fractures from the open hole injection interval up into our Fusselman waterflood zone."⁶³

Hydraulic Fracture Stimulation Post Job Report Analysis

A hydraulic fracture stimulation ("frac") performed on the Self 1401 well in 1990 included radioactive tracer in the proppant. Mr. Belcher analyzed the post-job report for this frac treatment and claims the radioactive tracer results indicate the presence of radioactive tracer across the perforations in the Fusselman formation and "the radioactive tracer going out behind the pipe out into the Sylvan shale."⁶⁴ Mr. Belcher asserts that there should not be any radioactive tracer below the Fusselman formation. Mr. Belcher claims that the frac grew down into the Sylvan shale, and the tracer results appear to show the Sylvan shale took more of the radioactive tracer than the Fusselman formation.⁶⁵

⁶¹ Tr. pg. 140, 8-10.

⁶² Tr. pg. 141, ln 4-6.

⁶³ Tr. *Id.*, ln 22-pg. 142, ln 12.

⁶⁴ Tr. pg. 143, ln 6-7.

⁶⁵ Tr. pg. 44, ln 7-17.

Recent Bottomhole Pressure (BHP) Surveys

Wagner has recent BHP survey results in the Field. The BHP for the Self 1003 was recorded on October 8, 2018 and measured 614.7 psig at a depth of 9,700 feet. The BHP for the Self 1502 was recorded on October 1, 2018 and measured 543.5 psig at a depth of 9,800 feet. The BHP for the Southeast Luther Fusselman No. 1401 was recorded on September 20, 2018 and measured 258.1 psig at a depth of 9,875 feet. Mr. Belcher contends the virgin pressure in the Montoya/Ellenburger formations would be around 4,500 psi.⁶⁶ Mr. Belcher claims that the approximate 4,000 psi reservoir pressure differential between the Ellenburger formation and the Fusselman formation could cause a fracture to grow from the Ellenburger formation into the Fusselman formation.⁶⁷ If this were to occur, Mr. Belcher asserts that it would cause waste by pushing injected fluids up into the Fusselman formation oil zone, at an up-dip location where Wagner contends remaining oil is banked.⁶⁸

On cross-examination, Mr. Belcher claims that the approximate 4,000 psi reservoir pressure differential between the Ellenburger formation and the Fusselman formation is not causing the migration of fluids between the formations at this time since there is not a large volume of fluids being injected into the Ellenburger formation right now. Mr. Belcher stated, "We haven't seen any signs of any migration."⁶⁹

Probity's Proposed SWD Well Location

Mr. Belcher asserts that structure maps indicate optional locations beyond the limits of the Fusselman porosity on Wagner's Unit where Probity could drill a disposal well if they chose to.⁷⁰ On cross-examination, Mr. Belcher maintained that it was Wagner's assertion that you cannot get sufficient cement bonding in wells on its acreage to prevent fluids from flowing from the Ellenburger formation up into the Fusselman formation.⁷¹

Mr. Belcher claims it will be very difficult for Probity to properly cement its proposed SWD well at the proposed location. Mr. Belcher asserts that if disposal operations were to occur at the proposed Hoss 846 SWD well location, the wellbore for this well would act as a conduit for fluids to escape the disposal interval and migrate into the Fusselman productive zone due to a poor cement job.

In addition, Mr. Belcher alleges, "that there are old wells that did penetrate the Ellenburger, the Montoya, and though our primary concern is annular travel injected fluid through the Probity well, there's also a possibility that injected fluids could find their way to some of the old wellbores that penetrated the injection zone, and those can find their way into our reservoir as well."⁷²

⁶⁶ Tr. pg. 146, ln 2.

⁶⁷ Tr. pg. 146, ln 3-7.

⁶⁸ *Id.* ln 11-21.

⁶⁹ Tr. pg. 150, ln 6 – pg. 152, ln 24.

⁷⁰ Tr. pg. 147, ln 17 – ln 21.

⁷¹ Tr. pg. 150, ln 13 – pg. 151, ln 6.

⁷² Tr. pg. 151, ln 11-17.

On-cross-examination, regarding whether Wagner would protest any Ellenburger disposal well in the area, Mr. Belcher stated, "We would not object to an Ellenburger disposal well outside of the pinch-out, the porosity pinch-out on the east. Very little of our acreage qualifies for that."⁷³

On further cross-examination, Mr. Belcher stated:

Q As a general proposition, not in terms of Probit, but anybody, if I understand your concept, you do not want any Ellenburger disposal within the zero contour that occupies -- within the zero contour on your acreage?

A That's correct.

Q All right. And that's as a result of you've got wells -- Wagner-operated wells that would be conduits up into -- from the Ellenburger into the Fusselman. Correct?

A Our protest is that the Probit well will send water into our -- our zones. Primarily it's very close and it's updip.

Q Yes, but I also heard you just say that there could be other wells that are -- of Wagner's that would be conduits. Correct?

A The initiation point would be the Probit well, but that water could find its way from some old wellbores.

Q So given -- so essentially that the Ellenburger has been condemned for disposal within the zero contour lines as to Wagner's acreage. Correct?

A Correct.

Q And Wagner's responsible for regulatory compliance with Railroad Commission regulations. Correct?

A That's correct.

Q So if the landowner wants to -- any landowner wanted to propose an Ellenburger disposal well, the condition of the Wagner wells would prohibit that -- I should say would cause Wagner to protest. Right?

A Any proposal within the zero line, yes.

Q So if what Wagner says is true, then -- are you familiar with Railroad Commission Statewide Rule 3.7?

⁷³ Tr. pg. 154, ln 1-ln 7.

A I am not.

Q Okay. Would you argue with me that the -- any reason to believe that this following passage is not correct: (As read) That *each stratum shall be adequately protected from infiltrating water* that is each oil and gas stratum?

A Yes.

Q Okay. So that's something Wagner -- so the problem Wagner has that is -- if its claim is true, that they would need a remedy. Correct?

A If it's true, it's proven it's true --

Q If the conduits you say exist, Wagner is under obligation to correct it. Correct?

A Correct. However, a lot of those wellbores have been plugged properly.⁷⁴

Luther Southeast Fusselman Unit Production History

Based on a historic decline curve of the Luther Southeast Fusselman Unit, Mr. Belcher asserts that the decline curve has been relatively flat or shows no decline over the past five-plus years, and this field has steadily produced 360 or so barrels per day. Mr. Belcher estimates the remaining reserves to be approximately 2 million barrels with current operations.⁷⁵ Mr. Belcher claims the Field is also a viable candidate for tertiary recovery, specifically CO₂ recovery, which could possibly yield another four-plus million barrels.⁷⁶

EXAMINERS' ANALYSIS OF THE EVIDENCE

Public Interest

The Examiners conclude that the proposed disposal well is in the public interest. The Protestant did not offer any contradicting evidence or rebut the Applicant's evidence that additional disposal is needed and will reduce water disposal costs.

Probity currently operate eight disposal wells, with a ninth recently drilled. Probity relies on input from its customers to determine customers' needs and where new disposal services are required. Probity currently operates one of the six active commercial disposal wells within a 5-mile radius of the subject application. The cumulative permitted

⁷⁴ Tr. pg. 155, ln 11-pg. 157, ln 10.

⁷⁵ Tr. pg. 149, ln 8-9.

⁷⁶ *Id.* ln 10-11.

injection volume for the six active commercial wells within 5-miles of the proposed disposal well is 106,000 bpd. Probit's active commercial disposal well is currently shut down for maintenance. However, when operational, the injection rate was between 23,000 to 27,000 bpd. The well is permitted to inject a maximum of 30,000 bpd.

Probit is pursuing this commercial disposal well permit at this location based on customer need. Probit plans the location of saltwater disposal facilities by working with customers on their future needs. In the Howard County area, a two-mile long horizontal well may produce between 1,500 to 4,100 bwpd on initial flowback. Two, three well pads can occupy an entire 25,000 barrel-a-day permitted disposal well by producing 1,500 to 4,100 bwpd on initial flowback on their initial production.

Adding a new disposal well location will shorten water hauling time by truck and reduce operation costs for operators. The proposed Hoss 846 SWD No. 1 will reduce water hauling costs in the area around the proposed well location. Probit is designing a pipeline system in Howard County to connect its existing disposal facilities in the county with the proposed Hoss 846 SWD.

The proposed disposal interval is the non-productive Montoya and Ellenberger formations. Operators in Howard County have a preference not to inject into the San Andres formation so as to avoid pressuring up the San Andres formation. Injecting into a non-productive formation deeper than the productive formations will prevent operators from having to drill through the disposal zone to drill producing wells.

Any Potential Harm or Injury to Any Oil, Gas, or Other Mineral Formation

Based on the evidence in the record, the Examiners recommend two additional special permit conditions: 1) the entire wellbore shall be cased; and 2) the operator shall run a cement bond log and submit the log to UIC prior to commencing disposal operations to ensure the cementing of the wellbore meets the requirements of Statewide Rule 13. With the addition of these two special permit conditions, the Examiners conclude the proposed disposal well will not harm or injure productive formations in the area if the disposal well is operated in accordance with the permit conditions and Commission rules.

Pursuant to Texas Water Code § 27.056(1), before setting the depth to which casing shall be installed, the Railroad Commission shall consider known geological and hydrological conditions and relationships. Based on the evidence in the record, the Examiners recommend a permit condition that the disposal interval be cased and cemented as opposed to Probit's proposed wellbore design of setting the casing at the top of the disposal interval with an open-hole disposal interval in the Montoya and Ellenberger formations. This permit condition addresses Wagner's concern of the potential for a poor casing shoe test at the top of the disposal interval, and potential channeling from the open-hole interval up behind the casing shoe, and possibly migrating up to the Fusselman formation as a result of a poor cement bond across the Sylvan shale. A second additional special permit condition is for the operator to run a cement bond log and submit the log to the Commission for review and evaluation to ensure the well is

cemented in accordance with Statewide Rule 13 prior to commencing injection operations.

The productive formations within two miles of the proposed Hoss 846 SWD location are the Clearfork, Spraberry, Dean, Wolfcamp, Silurian, Devonian, and Fusselman formations from 6,300 feet to 9,982 feet. These formations are all shallower than the proposed disposal interval within the Montoya and Fusselman formations. The evidence in the record shows the Sylvan shale directly overlies the top of the proposed injection interval in the Montoya and Ellenburger formations. Based on offset well logs, Probit's engineering witness estimated the thickness of the Sylvan shale to range between 50 and 70 feet, whereas Wagner's expert witness estimated the thickness of the Sylvan shale to vary between 50 and 85 feet. Based on the evidence in the record, the Examiners conclude there is a minimum of 50 feet of Sylvan shale located directly above the proposed disposal interval in the Montoya and Ellenburger formations, which is between the proposed disposal interval and all productive formations within two miles of the proposed well location, which all occur at shallower depths.

Wagner's expert witness and Probit's expert witness disagree on the ability of the Sylvan shale to act as a confining interval between the proposed disposal interval and productive formations. Based on a review of all of the evidence in the record, the Examiners conclude the Sylvan shale will act as a confining interval to protect productive formations.

Probit's Exhibit No. 18, which includes the summary of testimony for applicant Texas Pacific Coal and Oil Company, the hearing where field rules were adopted for the Field in which Wagner's wells are producing from, describe the porous productive zone of the Field to be underlain by a dense nonproductive limestone member, usually 5 to 10 feet thick and impermeable shale underlying the Fusselman. The testimony further describes the occurrence of shale and dense limestone above and below the porous Fusselman zone as illustrated on the cross-section included in that hearing, which Probit also included as an exhibit (Probit Exhibit No. 19). The testimony in that hearing attributed the occurrence of the continuous underlying dense limestone and shale members as serving as an effective barrier to negate the possibility of any bottom water drive.

Wagner's characterization of the Sylvan shale as a brittle fissile shale is based on a core sample from the upper 26.4 feet of a core sample taken from one well in the Field, the Southeast Luther Unit 26-2 (Wagner Exhibit No. 14, page 2⁷⁷), which described the shale as fissile. The minimum estimated of the thickness of the Sylvan shale by Wagner's and Probit's expert witnesses is 50 feet. There is no core information for the lower 24-plus feet of Sylvan shale in this well. In addition, the mere fact that the shale is fissile, it would still require a force, or pressure exerted on this shale that exceeds its tensile strength in order to cause tensile failure for this shale to fracture. The Commission has established a maximum surface pressure limitation in this area of 0.5 psi per foot to the top of the injection interval which provides adequate assurance that injection will not initiate new fractures or propagate existing fractures in the confining zones. In addition,

⁷⁷ Wagner Exhibit No. 14 is included with the PFD as an attachment.

the proposed disposal interval is the Montoya and Ellenburger formations, so the pressure will be exerted on the disposal formation at points of injection within these formations and will dissipate the farther fluid travels from the initiation points in the disposal interval. Wagner's claim that the Montoya/Ellenburger formations are likely fractured is not supported by any evidence in the record.

Additional evidence in the record that supports the finding that the Sylvan shale will act as a confining interval between the proposed disposal interval and productive formations is provided in Wagner Exhibit No. 14,⁷⁸ which included core data for three additional wells in the Fusselman interval where Wagner's wells are completed. Wagner's expert witness described the Woodford shale located above the Fusselman as the top seal that creates a trap, and attributed this top seal to be a reason why the Fusselman is productive. The core description for the Self Unit 29-1 lists the top of the Fusselman at 9,880 feet. This core did not include the Sylvan shale below the Fusselman. However, the core description does include 11 feet of core information for the Woodford Shale above the top of the Fusselman. The core description for 11 feet of the Woodford Shale above the top of the Fusselman describes several feet of fissile shale, including a one-foot interval that is described as fissile shale with conical fracture. There is also a one-foot interval described as shale with a calcite-filled fracture. Wagner's assertion is that the Sylvan shale below the Fusselman is fissile/brittle, based on a core description for one well, yet a core description for another well describes the Woodford Shale above the Fusselman with the same fissile shale description, while also describing natural fractures.

Based on the evidence in the record, the Examiners conclude that a core sample that lists a shale as fissile and indicates some natural fractures such as shown in the Woodford formation above the productive Fusselman formation where Wagner's wells are completed and has acted as an upper seal for the productive Fusselman formation rebuts Wagner's claim that the Sylvan shale is fissile and brittle and cannot act as a confining interval.

Further evidence in the record that supports the finding that the proposed Hoss 846 SWD well will not harm or injure productive formations is provided in Wagner Exhibit No. 14, page 5. A coregraph for the Puckett No. 2 in the Field indicates the lowermost three feet of the Fusselman formation directly above the Sylvan shale is impermeable, which matches the description of the base of the Fusselman in the field rule hearing where field rules were adopted for the Field. Based on the evidence in the record, the Examiners conclude that Wagner's evidence that the majority of the Fusselman interval was perforated in wells in the Field is not persuasive evidence to rebut the coregraph data showing that the base of the Fusselman formation is impermeable, and Probit's witness testimony that fluids will be confined to the disposal interval.

The Examiners conclude there is no evidence in the record that supports Wagner's claim that a reservoir pressure/pore pressure differential between the proposed disposal interval at virgin pressure will fracture the under-pressured Fusselman formation. The estimated reservoir pressure at the top of the proposed disposal interval at 10,004 feet is

⁷⁸ Wagner Exhibit No. 14, pages 3-5.

approximately 4,500 psi. The evidence in the record shows this reservoir pressure is similar to the original reservoir pressure in the Fusselman formation, as Wagner Exhibit No. 3 lists the initial bottomhole pressure of the Spencer No. A-1 on September 3, 1953 to be 4,246 psi, and the initial bottomhole pressure for the Little No. 1 on December 16, 1953 to be 4,260 psi. The evidence in the record showing wells currently completed in the Field with bottomhole pressures measured in the Fusselman formation ranging between 258 psig and 658 psig is further evidence that shows the Sylvan shale acts as a confining interval between the proposed disposal interval in the Montoya/Ellenburger and the Fusselman based on this pressure differential.

Wagner is concerned that there is a high likelihood of a poor casing shoe test. And with the injection rates and pressure proposed by Probity, injection will likely break down the cement at the casing shoe, if any, and due to a history of poor cement bond across the Sylvan shale, injection fluids will channel upwards from the open-hole disposal interval, behind un-cemented casing across the Sylvan shale, and into the low pressure Fusselman oil production zone. Probity proposes to set the long-string casing near the top of the proposed injection interval and have an open-hole disposal interval of approximately 1,000 feet. A casing shoe test yields valuable data in determining the formation breakdown pressure below the casing shoe, but may reduce the casing shoe strength after testing. The Examiners conclude there is evidence in the record of poor cement bond exhibited across Sylvan shale as shown by casing bond logs for four wells drilled and cemented in 2005. However, the Examiners conclude there is insufficient evidence to support Wagner's claim that you cannot design a cement program to sufficiently cement the proposed disposal well to prevent fluids from escaping the disposal interval. There is no evidence in the record of Wagner attempting to drill and cement a well through the Sylvan shale and Montoya/Ellenburger formations. The evidence shows that the most recent wells drilled and cemented in the Field were in 2005 by Chesapeake, and Wagner is not aware of any evidence that Chesapeake changed the cement blend or well conditioning program to attempt to address the poor cement bond across the Sylvan shale.

The only cement design information in the record is listed on page 19 of Wagner Exhibit No. 15, which is a summary of the well history for the SELF Unit No. 1904W. The report indicates the well was drilled and completed by Enserch Exploration, Inc. and shows a 5-1/2 inch long string casing cemented with a two-stage cement design with a DV tool set at a depth of 5,049 feet, with the first stage consisting of 200 sacks of 14.5 lb per gal 50/50 Pozmix, with 100 sacks of 15.6 lb per gal Class H cement, for a total of 300 sacks of cement pumped in stage 1, while there is a note that State shows 400 total sacks. This appears to be a discrepancy between a reported and actual amount of cement pumped. In addition, there is no evidence of any cement additives added to the Class H cement to address any potential problems cementing across the Sylvan shale.

The issue raised by Wagner that one of the few frac attempts in the Fusselman broke down into the Sylvan shale is additional evidence of channeling behind casing from the Fusselman formation to the Sylvan shale. The Examiners conclude that the evidence on the record is inconclusive as to Wagner's assertion that the hydraulic fracture stimulation designed for the Fusselman formation also hydraulically fractured into the Sylvan shale. Wagner Exhibit No. 16 did not include a written analysis of the proppant

tracer results, but only a log that stated the Fusselman formation was a treated zone, then channel down to the Sylvan shale, and then major treated zone at the Sylvan shale depth. Typically, the tagged sand indicates which perforations proppant entered, to determine whether all perforations took proppant, but does not estimate the distance that proppant travelled into the formation. In this case, one possible explanation for the tracer results in the Sylvan shale is the tagged sand is only behind casing across the Sylvan shale and not actually in the Sylvan shale, which indicate tracer across the entire length of the channel behind pipe.

Regardless of the tracer survey results, the proposed disposal well will be cemented across both the Fusselman and Sylvan shale formations, and injection will be into the Montoya and Ellenburger formations. Injection at pressures exceeding fracture pressure is not allowed under Statewide Rule 9. Statewide Rule 9 requires that injected fluids remain confined to the authorized disposal interval, since injection at or above formation fracture pressures may allow injected fluids to migrate through the fractures into adjoining zones, or to "go around" the production casing annular cement and escape the authorized zone.⁷⁹

Probit's engineering witness reviewed all P&A'd wellbores within a quarter-mile of the proposed disposal well location and testified that all were properly plugged. Wagner did not rebut Probit's witness' testimony or provide any evidence to the contrary. Based on the evidence in the record, the Examiners conclude that all wells within a quarter-mile of the proposed disposal well location are properly plugged.

Wagner did raise a concern that a total of 13 wells penetrated the top of the disposal interval and many of the wells in the field are old wells that have experienced casing leaks. However, Wagner did not identify any specific wells that will act as a conduit. Wagner's closest well that penetrated the disposal interval is about 0.83 miles away. Probit rebutted Wagner's claim that wells of vintage age may be a conduit for water to escape from the proposed disposal interval and enter the productive Fusselman formation by pointing out that Wagner's producing wells in the field must be in compliance with Statewide Rule 7:

"Whenever hydrocarbon or geothermal resource fluids are encountered in any well drilled for oil, gas, or geothermal resources in this state, such fluid shall be confined in its original stratum until it can be produced and utilized without waste. Each such stratum shall be adequately protected from infiltrating waters...."

Wagner's concern that the proposed disposal well location will penetrate approximately 6 feet of Fusselman porosity at an up-dip location is contemplated in Statewide Rule 9:

"Whenever hydrocarbon or geothermal resource fluids are encountered in any well drilled for oil, gas, or geothermal resources in this state, such fluid

⁷⁹ <https://www.rrc.texas.gov/about-us/resource-center/faqs/oil-gas-faqs/faq-injection-and-disposal-permit-applications/>

shall be confined in its original stratum until it can be produced and utilized without waste. Each such stratum shall be adequately protected from infiltrating waters. Wells may be drilled deeper after encountering a stratum bearing such fluids if such drilling shall be prosecuted with diligence and any such fluids be confined in its stratum and protected as aforesaid upon completion of the well. The commission will require each such stratum to be cased off and protected, if in its discretion it shall be reasonably necessary and proper to do so."

There is no evidence in the record to support Wagner's claim that the proposed disposal well "could contaminate the oil and could push it around."⁸⁰ Wagner is currently waterflooding its Unit in the Field, which implies that there will be movement of oil across lease lines in the Unit. In addition, Wagner's witness testified that its waterflood is no longer a pattern waterflood,⁸¹ and did not know the distance to the nearest producer or injector well on its Unit to the proposed Hoss 846 location.

Protection of Ground and Surface Fresh Water

Based on the evidence in the record, the Examiners conclude that the disposal formation is adequately separated from freshwater formations by impervious beds which will provide protection to freshwater formations. The proposed disposal interval is between 10,004 feet and 11,000 in the Montoya and Ellenburger formations. The GAU estimates that the BUQW occurs from the land surface to a depth of 300 feet, and base of the USDW is estimated to occur at a depth of 1,300 feet. The proposed disposal interval is deeper than the BUQW and USDW. The GAU also estimates geologic isolation from the BUQW and the USDW is at a depth of 1,750 feet. An offset well log less than 1,000 feet from the proposed Hoss 846 SWD location indicates impermeable strata between the proposed disposal interval in the Montoya and Ellenburger formations and the BUQW and USDW. The offset well log indicates the Wolfcamp Shale is at a depth from roughly 7,410 feet to at least 7,900 feet. This is a shale interval that is more than 250 feet thick of cumulative shale thickness and more than a hundred feet of continuous thickness between the top of the injection zone and the BUQW. Therefore, the disposal interval within the Montoya and Ellenburger formations will be separated from freshwater formations by impervious beds which will give adequate protection to such freshwater formations.

The Examiners conclude that the proposed well construction of the Hoss 846 SWD well will adequately protect both ground and surface fresh water. The BUQW occurs at a depth of 300 feet and the base of USDW at a depth of 1,300 feet at the proposed disposal well location. The well construction plan is to set 13-3/8 surface casing at depth of 375 feet and circulate cement to surface to isolate the BUQW.

There is one producing well and three P&A'd, wells within a quarter-mile area of review around the proposed location of the Hoss 846 saltwater disposal well. The producing well is operated by Sabalo and completed in the Field, producing from the

⁸⁰ Tr. pg. 121, ln 20.

⁸¹ Tr. pg. 172, ln 2-4.

Fusselman formation. Probity's engineering witness testified that all of the P&A'd wells are properly plugged and will not act as conduits for fluid to escape the injection zone based on a review of the plugging records for the P&A'd wells. No evidence to the contrary was entered into evidence. The Examiners conclude that none of the P&A'd wells within a quarter-mile area of the proposed location of the Hoss 846 SWD well will act as a conduit for fluids to escape the permitted disposal interval.

Financial Assurance

At the time of the hearing, Probity (Operator No. 679304), had an active P-5 organization report and a \$50,000 cash deposit as financial assurance.

Additional Information

No seismic activity has been reported within a 100 square miles of the proposed disposal well location. USGS seismic data between January 1, 1973 and June 7, 2018 shows no seismic activity has been reported within 100 square miles of the proposed disposal well location.

FINDINGS OF FACT

1. Probity SWD, LLC seeks a permit authorizing commercial disposal operations pursuant to 16 Tex. Admin. Code § 3.9 for the Hoss 846 SWD Lease, Well No. 1, Luther SE. (Silurian-Devonian) Field, Howard County, Texas.
2. Notice of the application (Form W-14) was mailed to the owner of the surface tract, owners of adjacent tracts, operators of wells within a one-half mile radius, and the Howard County Clerk.
3. Notice of the application was published in the *Big Spring Herald*, a newspaper of general circulation in Howard County, on May 30, 2018.
4. The application is currently protested by Wagner, an operator with wells within one half-mile of the proposed disposal well location.
5. At least 10 days' notice of the hearing was provided to the owner of the surface tract, to adjacent surface owners, to the Howard County Clerk, and to operators with active wells within one half-mile of the Hoss 846 SWD Lease, Well No. 1 location. 16 Tex. Admin. Code § 3.9(5)(E)(i).
6. The use or installation of the Hoss 846 SWD Lease, Well No. 1 is in the public interest.
 - a. There are six active commercial disposal wells within a 5-mile radius of the proposed Hoss 846 SWD Lease, No. 1.

- b. The cumulative permitted injection volume for the six active commercial wells within 5-miles of the proposed disposal well location is 106,000 bpd.
 - c. In the Howard County area, a two mile long horizontal well may produce between 1,500 to 4,100 bwpd on initial flowback.
 - d. Two, three well pads can occupy an entire 25,000 barrel-a-day permitted disposal well by producing 1,500 to 4,100 bwpd on initial flowback on their initial production.
 - e. Adding a new disposal well location will shorten water hauling time by truck and reduce operation costs for operators in this area.
7. The use or installation of the Hoss 846 SWD Lease, Well No. 1 will not endanger or injure oil, gas, or other mineral formations.
- a. The injection interval is in the Montoya and Ellenburger formations from 10,004 feet to approximately 11,000 feet. A special permit condition stipulates that injection shall be no deeper than 100 feet above the estimated base of the Ellenburger formation as determined by the RRC using the log and/or the estimated Ellenburger thickness at the well location.
 - b. The productive zones within two miles of the Hoss 846 SWD Lease, Well No. 1 are the Clearfork, Spraberry, Dean, Wolfcamp, Silurian, Devonian, and Fusselman formations from 6,300 feet to 9,982 feet. These formations are all shallower than the proposed disposal interval within the Montoya and Fusselman formations.
 - c. The Sylvan formation, a shale, directly overlies the top of the proposed injection interval in the Montoya and Ellenburger formations.
 - d. The Sylvan formation is a shale that is at least 50 feet thick at the Hoss 846 SWD Lease, Well No. 1 location that will act as a confining interval to prevent injected fluids from escaping the top of the disposal interval.
 - e. A coregraph for the Puckett No. 2, completed in the SE Luther Field in Howard County, indicates the lower 3 feet of the Fusselman formation directly above the Sylvan shale is impermeable.
 - f. A special permit condition that requires the entire wellbore be cased, and a special permit condition that requires a cement bond log be run and submitted to the Commission prior to commencing injection operations to confirm the well is cased and cemented in accordance with Statewide Rule 13 will ensure that the wellbore of the Hoss 846 SWD Lease, Well No. 1 will not act as a conduit for injected fluids to escape the permitted disposal interval.

8. With proper safeguards, both ground and surface fresh water can be adequately protected from pollution.
 - a. The disposal interval is between 10,004 feet and 11,000 in the Montoya and Ellenburger formations.
 - b. The GAU estimates that the BUQW occurs from the land surface to a depth of 300 feet, and base of the USDW is estimated to occur at a depth of 1,300 feet. The disposal interval is deeper than the BUQW and USDW.
 - c. The GAU estimates geologic isolation from the BUQW and the USDW is at a depth of 1,750 feet.
 - d. An offset well log less than 1,000 feet from the Hoss 846 SWD Lease, Well No. 1 location indicates impermeable strata between the proposed disposal interval in the Montoya and Ellenburger formations and the BUQW and USDW. The offset well log indicates the Wolfcamp Shale is at a depth from roughly 7,410 feet to at least 7,900 feet. This is a shale interval that is more than 250 feet thick of cumulative shale thickness and more than a hundred feet of continuous thickness between the top of the injection zone and the BUQW.
 - e. The well construction plan is to set 13-3/8-inch surface casing at a depth of 375 feet and circulate cement to surface to isolate the BUQW, which occurs from surface to a depth of 300 feet.
 - f. The injection interval is in the Montoya and Ellenburger formations between 10,004 feet and 11,000 feet, which is deeper than the BUQW and the USDW.
 - g. Probitry SWD, LLC provided a letter from the GAU of the Oil and Gas Division with its application that stated, "Our review of the data contained in the application and of other available geologic data indicates, if otherwise compliant with Railroad Commission rules and guidelines, that drilling and using this disposal well and injecting oil and gas waste into the subsurface stratum will not endanger the freshwater strata in that area."
 - h. There are three plugged and abandoned wells within a quarter mile of the Hoss 846 SWD Lease, Well No. 1 location. Evidence in the record indicates the wells were plugged in accordance with Commission rules and will not act as a conduit for injected fluids to escape the disposal interval.
9. A review of USGS seismic data shows no seismic events have been reported within 100 square miles of the proposed disposal well location.
10. At the time of the hearing, Probitry SWD, LLC (Operator No. 679304) had an active P-5 and a \$50,000 cash deposit as financial assurance.

CONCLUSIONS OF LAW

1. Resolution of the subject application is a matter committed to the jurisdiction of the Railroad Commission of Texas. Tex. Nat. Res. Code § 81.051.
2. All notice requirements have been satisfied. 16 Tex. Admin. Code § 3.9.
3. The use or installation of the proposed disposal well is in the public interest. Texas Water Code § 27.051(b)(1).
4. The use or installation of the proposed disposal wells will not endanger or injure any oil, gas, or other mineral formation. Texas Water Code § 27.051(b)(2).
5. With proper safeguards, both ground and surface fresh water can be adequately protected from pollution. Texas Water Code § 27.051(b)(3).
6. Probity SWD, LLC has made a satisfactory showing of financial responsibility. Texas Water Code § 27.051(b)(4).
7. With special permit conditions, Probity SWD, LLC has met its burden of proof and the application for the Hoss 846 SWD Lease, Well No. 1, satisfies the requirements of Chapter 27 of the Texas Water Code and the Railroad Commission's Statewide Rule 9.

EXAMINERS' RECOMMENDATION

Based on the above findings of fact and conclusions of law, the Examiners recommend that the application of Probity SWD, LLC for commercial disposal authority pursuant to Statewide Rule 9 for the Hoss 846 SWD Lease, Well No. 1, Luther, SE. (Silurian-Devonian) Field, Howard County, Texas, **be approved with special permits conditions**, as set out in the attached Final Order and draft permit.

Respectfully,



Karl Caldwell, P.E.
Technical Examiner



Kristi M. Reeve
Administrative Law Judge