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Addendum-1
December 15, 2023

ANNUAL CLASS III WELL REPORT FOR 2022

Wasserhund Inc.
Buckeye Brine Station
OCD Permit BW-04

API No. 30-025-26883 Eidson #1
Unit Letter M-Section 31-Ts 16s – R35e

Wayne Price-Price LLC Consultant for Wasserhund Inc.



Date: December 16, 2023

Dear Carl Chavez:

Recently you expressed in an E-mail Dec 4, 2023 (*attached herein*) a concern on how the D/H ratio ("Diameter" of cavern roof versus the "Height" measured above the roof to the surface) was calculated in the 2022 Annual Report: Price LLC on behalf of Wasserhund Inc. brine well permit BW-04 hereby submits this Addendum-1 to address your concerns.

If we interpreted your concern correctly, you had indicated that the original casing shoe, which was set at 1895 feet BGS, should probably be a reference point in these calculations. In addition, you noted in the E-mail that the Cavern depth should probably be measured from the casing shoe depth to a Total "TD" rather than from where the production tubing is set.

Quote: "OCD is currently working with Permittees of Brine Wells in the estimation of the above subject "Right Circular Cone" (RCC) calculation [$V = \pi r^2 h / 3$] based on the salt cavern cavity volume and estimated cavern height. By obtaining the "Maximum diameter of the salt cavern, the application of the "D (Max. Cavern Diameter in Ft.)/H (Depth to Casing Shoe in Ft.- D/H)" ratio can be calculated for the certification in the annual report."

"OCD has noticed a wide variation in estimated salt cavern cavity volume estimations and values of "h" that may not be the most accurate estimation. For example, the brine well TD minus the casing shoe depths may be more accurate than subtracting the tubing depth from the casing shoe depth in the estimation of h."

"For example, the brine well TD minus the casing shoe depths may be more accurate than subtracting the tubing depth from the casing shoe depth in the estimation of h."

Please note your h is not the "H" used in the Ratio Calculation.

Attached herein is the latest well bore sketch that was superimposed on a nearby well log for reference.

The "D" (Diameter of roof cavern in feet) has been calculated using an up-right cone with the formula $D = \text{Square Root of } (3 \cdot V / \pi \cdot \text{cavern length measured from roof to the injection depth})$. V in this formula is the estimated total amount of salt that has been removed in cubic feet.

Historically for every barrel of 10 lb. brine water volume removed equates to approximately one cubic foot of salt, which creates a void of one cubic foot, and over time creates a salt cavern.

The "V" volume used in these calculations are based on the historical total recorded and reported cumulative volume of produced brine water. The 2022 total lifetime production beginning in 1980 was 10,143,420 barrels.

Using the Constant of for every barrel produced equals approximately one cubic foot of cavern volume created; the total lifetime cavern volume is approximately 10,143,420 cubic feet.

In order to verify the measured salt removed volume versus the calculated salt volume removed, OCD has been requiring a Mass Balance Calculation Sheet. This basically verifies if the i.e. up-right cone model in calculating the volume is within a 10% tolerance of actual measured volume. Attached is the 2022 Mass Balance Sheet that verifies the accepted tolerance.

The 2022 report used a casing shoe depth of 2100 ft. (overburden) and a Cavern depth of 360 ft. The Roof diameter was calculated using the total lifetime production of 10,143,430 barrels i.e. (10,143,430 cubic ft.). This calculated a cavern roof diameter to be approximately 328 feet. Using these numbers the D/H calculation was reported at .156, well below the .50 threshold.

However, if we use the method you suggested with the original casing shoe depth of 1895 ft. BGS and use the cavern "h" of 660 ft. (2555' TD-1895' casing shoe); using the formula given above, the new D/H calculated number is .128.

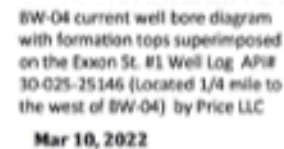
So it appears our submitted calculation is approximately 20% more protective.

In an earlier E-mail you had sent your calculation of the D/H ratio as being approximately .38. Enclosed is a copy of your work sheet. As explained it appears you may have used the wrong constant of 5.61458 cubic ft/barrel versus the standard for every barrel of 10 lb. brine water produced it creates a cavity of approximately one cubic foot, not 5.61458 cubic ft.

Conclusion:

On behalf of Wasserhund Inc we respectfully request that OCD accept our calculations for the D/H ratio as submitted.

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BW-4 Edison State #1, Wasserhund, Inc.: OCD Right Circular Cone Formula Calcs., for V (Cavern Cavity Vol.) and h (Cavern Height) for D/H Ratio Estimation

← Chavez, Carl, EMNRD
to me, Phillip. ▸

Mon, Dec 4, 2:49 PM (12 days ago)

Wayne,

Re: OCD BW-4 Annual Report 2022 Action ID# 263318) Review

111

I presented your recent Annual Report 2022 Salt Cavern Estimation to the UIC Group.

COCD is currently working with Permittees of Brine Wells in the estimation of the above subject "Right Circular Cone" (RCC) calculation [$V = \frac{1}{3} \pi r^2 h$] based on the salt cavern cavity volume and estimated cavern height. By obtaining the Maximum diameter of the salt cavern, the application of the "D" (Max. Cavern Diameter in Ft./Y/H (Depth to Casing Shoe in Ft.- D/H)) ratio can be calculated for the certification in the annual report.

OCDD has noticed a wide variation in estimated salt cavern cavity volume estimations and values of "h" that may not be the most accurate estimation. For example, the brine well TD minus the casing shoe depths may be more accurate than subtracting the tubing depth from the casing shoe depth in the estimation of h.

Please refer to the OCD's calculation of "D" based on the cumulative brine cavity volume derived from the Brine Well Working Group's "Useful Conversions" for 10 lb. Brine (See attachment). You may recall the attached conversions from the Brine Working Group in 2008 – 2009. Please refer to the attached "Ratio Calc Final" document (Case 3) for OCD's estimation of salt cavern space volume based on the conversions.

OCOD thinks the "Useful Conversions" sheet may help brine well Permittees to use a standard uniform method of calculating and estimating D and V. OCOD would like all brine well permittees to follow a uniform process for implementing the GCC Formula that the OCOD would accept and review.

Please let OCD know your thoughts based on our approach at your earliest convenience. Meanwhile, OCD is proceeding to complete its review of the BW-4 Annual Report 2022 (Action ID# 263318).

Thank you.

Carl J. Chavez • UIC Group

Engineering Bureau

FEMNRD - Oil Conservation Division

Horizon Building

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[illegible]

MAX. CAVERN DIAMETER CALCULATION

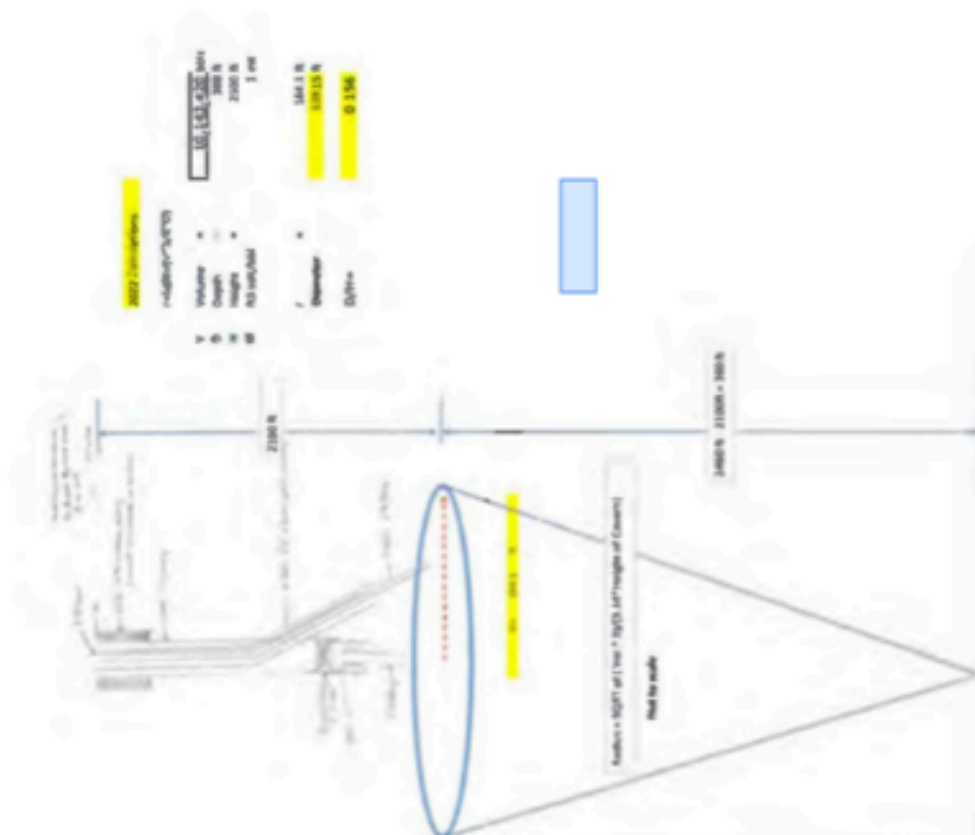
$$r = S_{qRt} (3V/3.14h)$$

$$h \text{ (Cavern Height)} = 360 \text{ Ft.}$$

D (Max. Cavern Diameter)= 778 Ft.

 $H(\text{Depth to Casing Shoe}) = 2,100 \text{ ft.}$ $D/H=0.370$ $1.68L = 5.61458 \text{ Ft}^3$

Fig 3. Salt/bbl = ?



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Oil Conservation Division
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Santa Fe, NM 87505

COMMENTS

Action 295323

COMMENTS

Operator: WASSERHUND INC P.O. Box 2140 Lovington, NM 88260	OGRID: 130851
	Action Number: 295323
	Action Type: [UF-DP] Brine Facility Discharge Plan (DISCHARGE PLAN BRINE EXTRACTION)

COMMENTS

Created By	Comment	Comment Date
cchavez	This submittal has been incorporated into and processed by the OCD under the original Action ID# 263318. This submittal is only an addendum and OCD provides review comments in the approval of Action ID# 263318.	1/9/2024

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cchavez	Conditions of Approval for this addendum are cited under the original Action ID# 263318.	1/9/2024