STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

OIL CONSERVATION DIVISION
POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501

FORM C-108
Revised 7-1-81

APPLICATION FOR AUTHORIZATION TO INJECT

I. Purpose: ☐ Secondary Recovery ☐ Pressure Maintenance ☒ Disposal ☐ Storage
Application qualifies for administrative approval? ☐ yes ☐ no

II. Operator: Hebco Oil Company

Address: 4381 Boy Scout Lane E1, Paso TX. 89922

Contact party: Kenneth Hand Phone: 915-584-6345

III. Well data: Complete the data required on the reverse side of this form for each well proposed for injection. Additional sheets may be attached if necessary.

IV. Is this an expansion of an existing project? ☐ yes ☒ no
If yes, give the Division order number authorizing the project _____.

V. Attach a map that identifies all wells and leases within two miles of any proposed injection well with a one-half mile radius circle drawn around each proposed injection well. This circle identifies the well's area of review.

* VI. Attach a tabulation of data on all wells of public record within the area of review which penetrate the proposed injection zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of completion, and a schematic of any plugged well illustrating all plugging detail.

VII. Attach data on the proposed operation, including:

1. Proposed average and maximum daily rate and volume of fluids to be injected;
2. Whether the system is open or closed;
3. Proposed average and maximum injection pressure;
4. Sources and an appropriate analysis of injection fluid and compatibility with the receiving formation if other than reinjected produced water; and
5. If injection is for disposal purposes into a zone not productive of oil or gas at or within one mile of the proposed well, attach a chemical analysis of the disposal zone formation water (may be measured or inferred from existing literature, studies, nearby wells, etc.).

*VIII. Attach appropriate geological data on the injection zone including appropriate lithologic detail, geological name, thickness, and depth. Give the geologic name, and depth to bottom of all underground sources of drinking water (aquifers containing waters with total dissolved solids concentrations of 10,000 mg/l or less) overlying the proposed injection zone as well as any such source known to be immediately underlying the injection interval.

IX. Describe the proposed stimulation program, if any.

* X. Attach appropriate logging and test data on the well. (If well logs have been filed with the Division they need not be resubmitted.)

* XI. Attach a chemical analysis of fresh water from two or more fresh water wells (if available and producing) within one mile of any injection or disposal well showing location of wells and dates samples were taken.

XII. Applicants for disposal wells must make an affirmative statement that they have examined available geologic and engineering data and find no evidence of open faults or any other hydrologic connection between the disposal zone and any underground source of drinking water.

XIII. Applicants must complete the "Proof of Notice" section on the reverse side of this form.

XIV. Certification

I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

Name: Denny Reeves Title Agent

Signature: _____ Date: _____

* If the information required under Sections VI, VIII, X, and XI above has been previously submitted, it need not be duplicated and resubmitted. Please show the date and circumstance of the earlier submittal. Logs were submitted after well was first drilled

DISTRIBUTION: Original and one copy to Santa Fe with one copy to the appropriate Division district office.

III. WELL DATA

A. The following well data must be submitted for each injection well covered by this application. The data must be both in tabular and schematic form and shall include:

(1) Lease name; Well No.; location by Section, Township, and Range; and footage location within the section.

(2) Each casing string used with its size, setting depth, sacks of cement used, hole size, top of cement, and how such top was determined.

(3) A description of the tubing to be used including its size, lining material, and setting depth.

(4) The name, model, and setting depth of the packer used or a description of any other seal system or assembly used.

Division District offices have supplies of Well Data Sheets which may be used or which may be used as models for this purpose. Applicants for several identical wells may submit a "typical data sheet" rather than submitting the data for each well.

B. The following must be submitted for each injection well covered by this application. All items must be addressed for the initial well. Responses for additional wells need be shown only when different. Information shown on schematics need not be repeated.

(1) The name of the injection formation and, if applicable, the field or pool name.

(2) The injection interval and whether it is perforated or open-hole.

(3) State if the well was drilled for injection or, if not, the original purpose of the well.

(4) Give the depths of any other perforated intervals and detail on the sacks of cement or bridge plugs used to seal off such perforations.

(5) Give the depth to and name of the next higher and next lower oil or gas zone in the area of the well, if any.

XIV. PROOF OF NOTICE

All applicants must furnish proof that a copy of the application has been furnished, by certified or registered mail, to the owner of the surface of the land on which the well is to be located and to each leasehold operator within one-half mile of the well location.

Where an application is subject to administrative approval, a proof of publication must be submitted. Such proof shall consist of a copy of the legal advertisement which was published in the county in which the well is located. The contents of such advertisement must include:

(1) The name, address, phone number, and contact party for the applicant;

(2) the intended purpose of the injection well; with the exact location of single wells or the section, township, and range location of multiple wells:

(3) the formation name and depth with expected maximum injection rates and pressures; and

(4) a notation that interested parties must file objections or requests for hearing with the Oil Conservation Division, P. O. Box 2088, Santa Fe, New Mexico 87501 within 15 days.

NO ACTION WILL BE TAKEN ON THE APPLICATION UNTIL PROPER PROOF OF NOTICE HAS BEEN SUBMITTED.

NOTICE: Surface owners or offset operators must file any objections or requests for hearing of administrative applications within 15 days from the date this application was mailed to them.

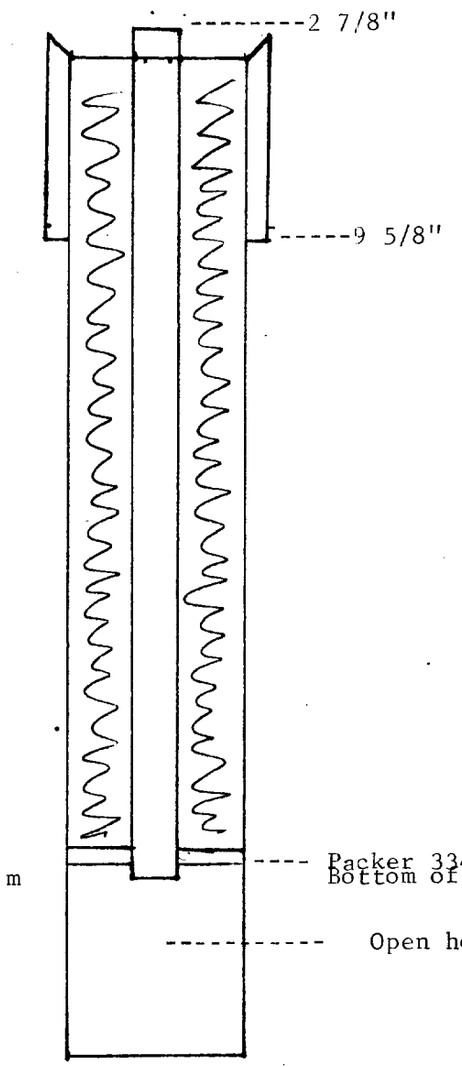
INJECTION WELL DATA SHEET

Hebco Oil Company — OPERATOR

Malco Copple — LEASE

Malco Copple #6 1980 FNL 1980' FEL Sec 5 T30N R15W — WELL NO. / FOOTAGE LOCATION / SECTION / TOWNSHIP / RANGE

Schematic



Tabular Data

Surface Casing

Size 10.75" Cemented with 120 sx.

TOC Surface feet determined by Circulation

Hole size 12 1/4

Intermediate Casing None

Size _____" Cemented with _____ sx.

TOC _____ feet determined by _____

Hole size _____

Long string

Size 5 1/2" Cemented with 150 sx.

TOC 1880 feet determined by Temp. survey

Hole size 7 7/8

Total depth 3462'

Injection interval

3341' feet to 3462' feet
(perforated or open-hole, indicate which)

open hole

- tested casing -
- ok -
no leaks detected
will not cement tubing in well

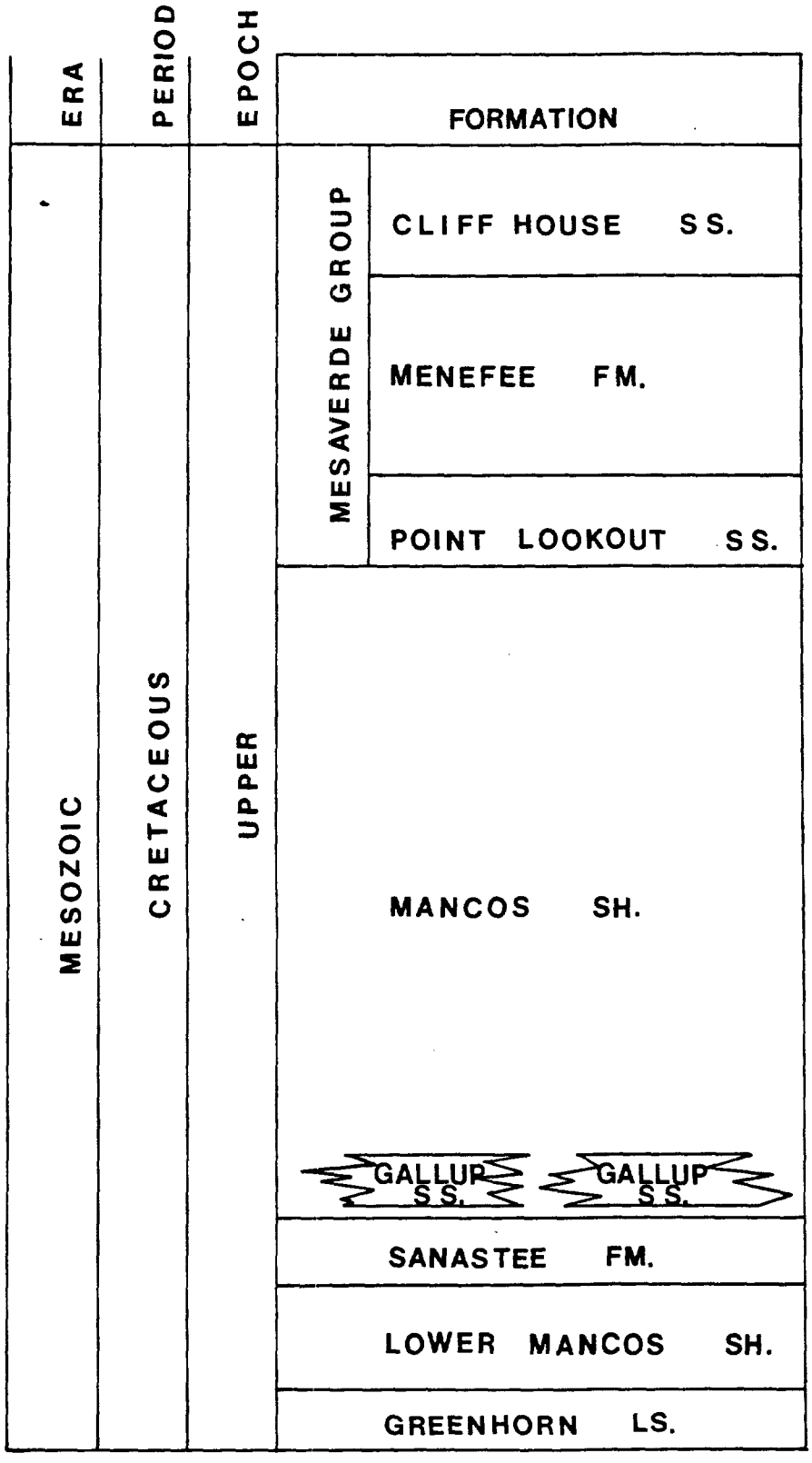
Tubing size 2 7/8 lined with _____ (material) set in a _____ (brand and model) packer at 3341' feet.

(or describe any other casing-tubing seal).

Other Data

1. Name of the injection formation Gallup Sandstone
2. Name of Field or Pool (if applicable) Verde Gallup
3. Is this a new well drilled for injection? ☐ Yes ☒ No

   If no, for what purpose was the well originally drilled? Oil Well
4. Has the well ever been perforated in any other zone(s)? List all such perforated intervals and give plugging detail (sacks of cement or bridge plug(s) used) no other perfs.
5. Give the depth to and name of any overlying and/or underlying oil or gas zones (pools) in this area. no overlying zones Next lower zone Greenhorn 200'



Upper Cretaceous lithologic units in San Juan basin.
Modified from Peterson, et. al. (1968).

Data sheet on wells in the area of review.

Malco Copple #7 Hebco Oil Company.
Temporarily abandone oil well.
10-3/4 48.00 LBS per ft. @ 129' Surface casing
5-1/5 15.50 Lbs per ft. @3622 Prod. casing — TOC calc. 2906' ok
4-1/2 16.60 Lbs per ft. @ 135'

Date drilled June 7 1958
Feid Verde Gallup
Sec. 5 T30N R15W NMPM San Jaun County
Location 1980' FSL 1980' FWL of Sec 5 Elevation 5381
Depth 3647'
Completion record, 0-129' surface casing, 0-3436' production casing, 3230'- 3436' liner. Surface casing cemented with 120 sacks of cement, circulation to surface Prodution casing cemented with 150 sacks of cement. Prodution liner set on bottom of hole, no cement.

Mal co Copple #3 Hebco Oil Company
Shut in
8-5/8 - 24.00 Lbs per ft. @ 122' Surface casing.
5-1/2 - 15.50 Lbs per ft. @ 2559' Production casing.
4-1/2 - 16.60 Lbs per ft. @192' Production liner.

Date Drilled May 1, 1957
Field Verde Gallup
Sec. 5, T30N, R15W NMPM San Jaun County
Location ~~1800~~' FNL 600' FWL Sec. 5 Elevation 5432'
Depth 2748'
Completion record, 0- 122' surface casing, 0 - 2569', production casing, 2556' -2748' production liner. Surface casing cemented with 150 sacks of cement, circulated to surface. Production casing cement with 150 sacks of cement, circulated from 2569' to 1930'. Production liner set on bottom of hole, no cement.

Malco Copple #8 Hebco Oil Company
Temporarily abandoned oil well.
10-3/4 - 32.75 Lbs. per. ft. @130' surface casing
5-1/2 - 15.50 Lbs. per. ft. @ 3202' production casing.
4-1/2 - 16.60 Lbs. per. ft. @ 217' production liner.

Date drilled August 25, 1957
Field Verde Gallup
Sec. 5 T.30N R1 5W. NMPM San Juan County.
Location 990 FNL 890 FEL Sec. 5 Elevation 5458.
Depth 3448'
Completion record, 0-130' surface casing, 0-3208' production casing, 3204-3421 production liner. Surface casing cemented with 200 sacks of cement, circulated to surface. Production casing cemented with 150 sacks of cement, circulated from 3208 to 2580. Production liner set in bottom of hole, no cement.

Sheila #1 Hebco Oil Company
Shut-in oil well.
9-5/8 - 36 Lbs per foot @ 125' Surface casing.
7" - 23 Lbs per foot @ 2542' Production casing.

Date drilled June 6, 1984
Field Verde Gallup
Sec. 5 T. 30N. R15W NMPM San JaunCounty.
Location, 765 FNL 2160 FEL Sec, 5 Elevation 5471.

Depth 2814'
Completion record, 0-125' surface casing, 0-2542' production casing, 2542-2814 open hole. Surface casing cemented with 60 sacks of class A cement, circulated to surface. Procuction casing cemented with 500 sacks cement, from 2542' to surface. Open hole completion.

E. Thurland #1 Pan American Petroleum Corp.
Plugged & Abandoned
Location, Sec. 6 T3ON R15W. 560' FNL 660' FEL of Sec. 6. Elevation 5354'
Date drilled, June 1, 1957
8-5/8" - 22.7 Lbs per foot @ 163'
5-1/2 - 14 Lbs per foot @ 2025'

B. O. A. #3 B. O. A. Oil & Gas Co.
Plugged & Abandoned
Location, Sec.32 T31N R15W NMPM Elevation 5471'
760' FSL 1980' FWL Sec1 32.
Date drilled Not available

Well # 5 W.M. Gallaway
Plugged & Abandoned
Location, Sec, 31, 131N, R15W. Elevation 5359'
660' FSL 660' FEL Sec1 31.
Date drilled, February 24, 1957
8-5/8" - 24 Lbs per foot @ 89'
5-1/2 - 14 Lbs per foot @ 1913'

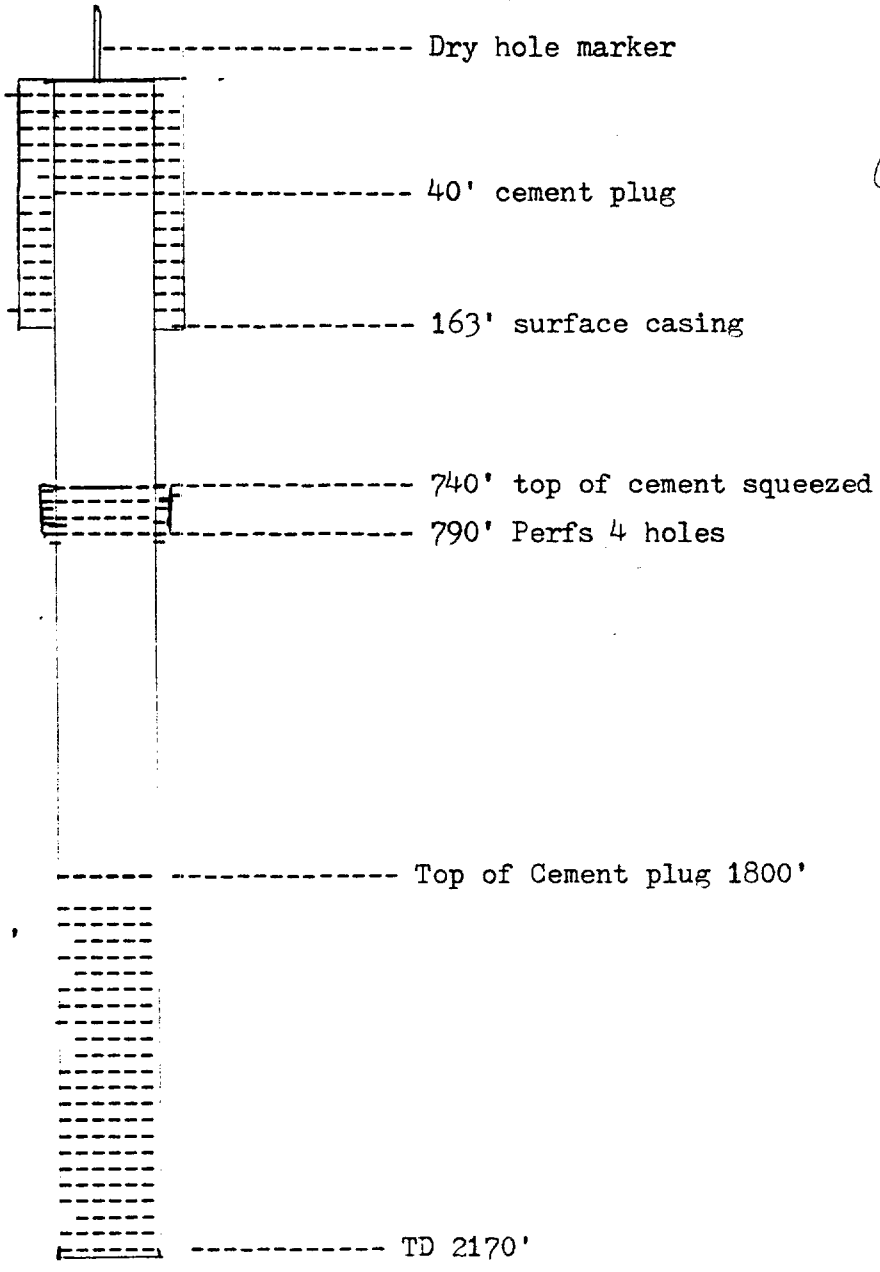
Westwater Federal #6 High Plains
Producing Oil Well
Location Sec. 6 T3oN R15W
Date drilled 4-30-86
Field Verde Gallup

← Check
Not in area of review

Schematic and details of plugged wells.

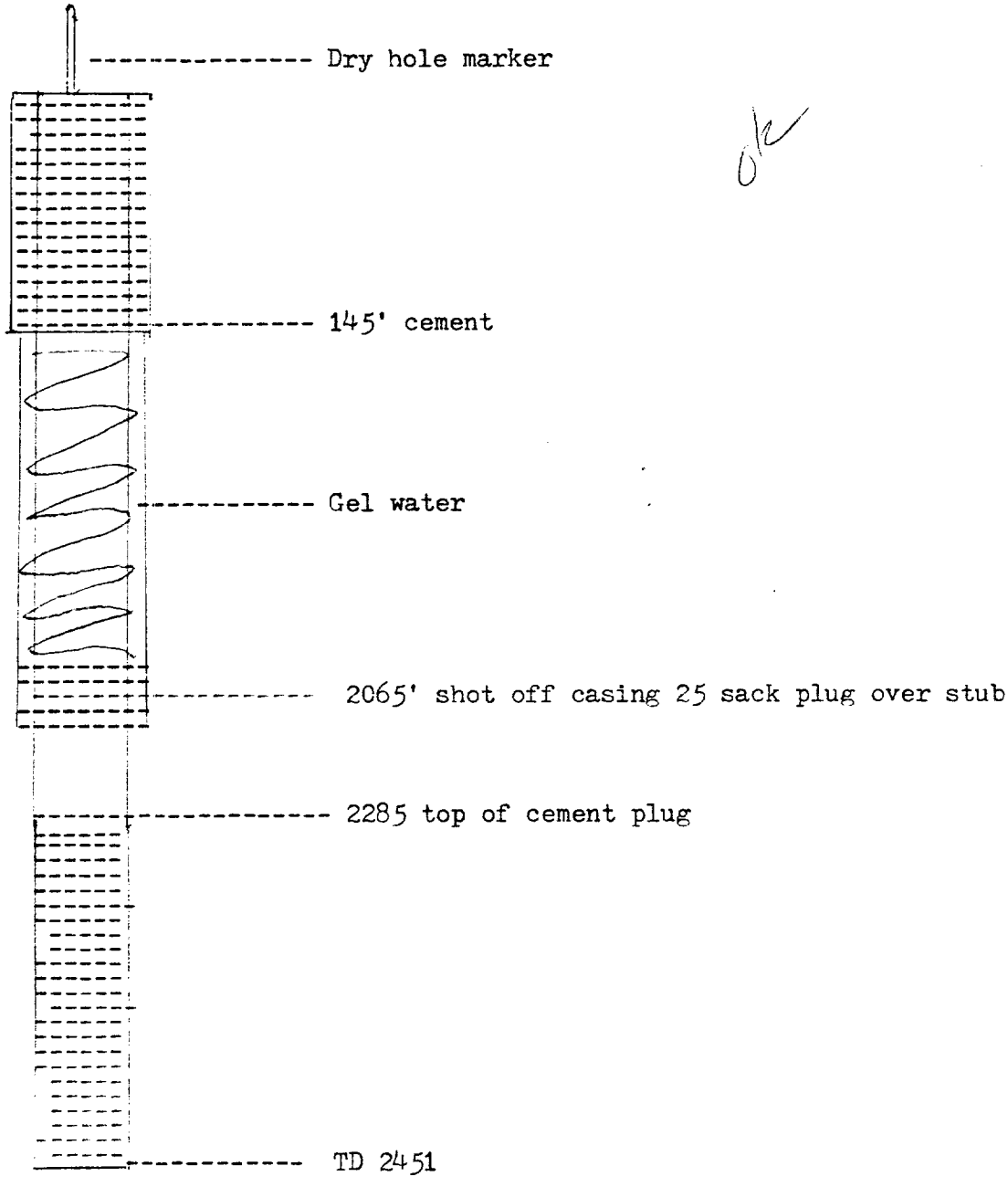
E. Thurland #1 Pan American Petroleum Corp.
Date plugged June 25 1965.

1.- Pumped 75 sack cement plug down 5-1/2" casing with cementing plug, left cement plug at 1800' and squeezing with 2500 psi.
2. Perforated 4 holes at 790' (base of Point Lookout sands) and squeezed 50 sacks of cement into perforations. Left top of cement plug at 740'.
3. Pumped 25 sacks of cement down 5-1/2" and up the anulus of 8-5/8" casing.
4. Spotted 5 sacks of cement from 0-40"', and erected dry hole marker.



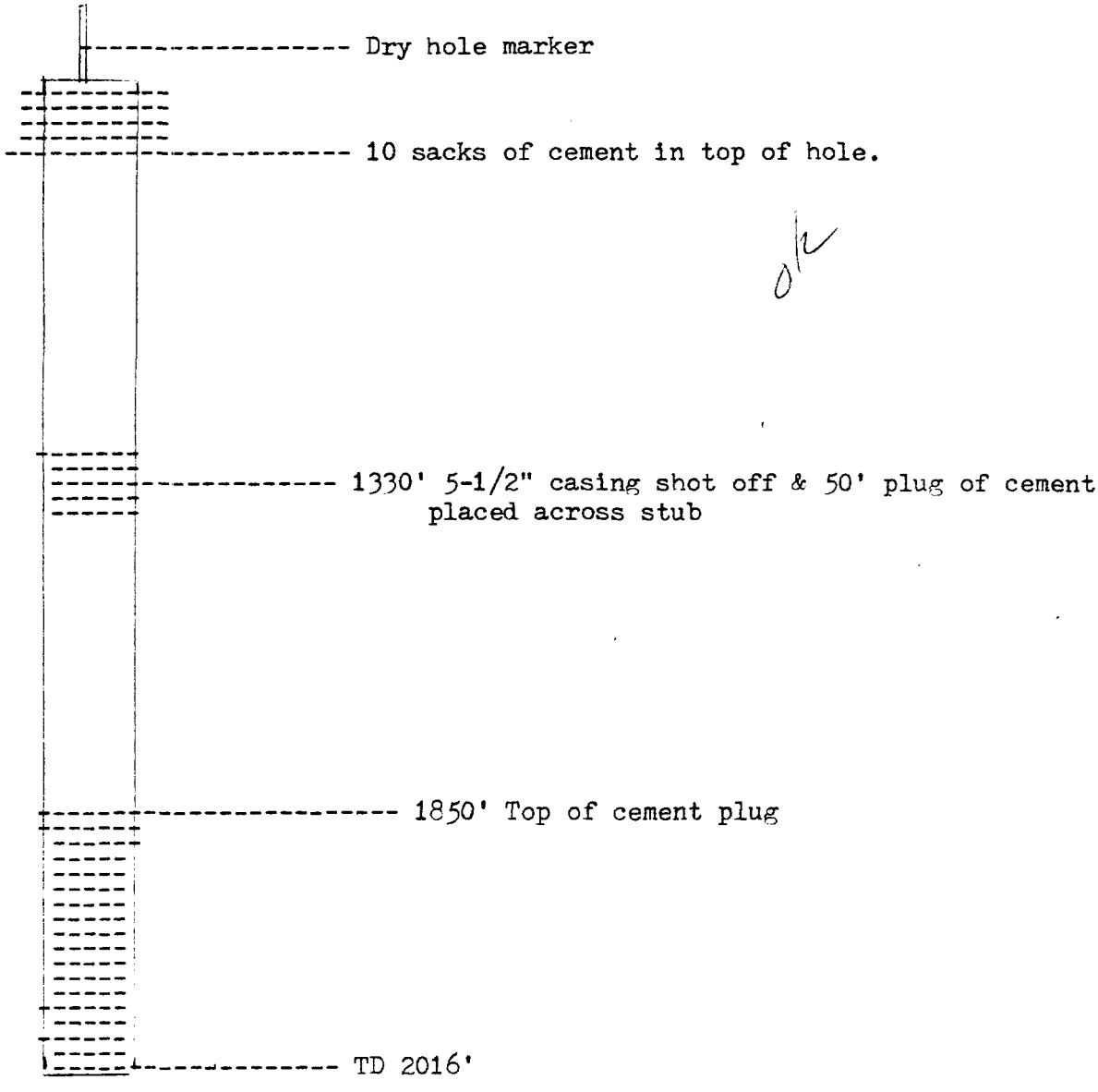
Well #3 B.O,A. Oil & Gas Co.
Date plugged September 20, 1980.

1. Ran tubing in hole and spotted 25 sack cement plug from 2451- 2285'
2. Shot casing of at 2065'. spotted 25 sack cement plug over stub of pipe.
3. Filled hole with treated gel water.
4. Set 40 sack cement plug from 145' to surface.
5. Errected dry hole marker.



Well #5 W.M. Gallaway
Date plugged December, 1970

1. Spot plug in the Gallup open hole from 1850'- 2016', which is 50' into 5-1/2"
2. shot off casing at 1330' and spotted plug 50' across casing stub.
3. Spotted 50' cement plug across bottom of surface casing at 89'.
4. Placed 10 sacks of cement in top of hole and erected dry hole marker.



Proposed operation for injection well.

1. The daily rate of injection of water will average between 100 to 400 barrels a day depending on the successfull restoration of the Malco Copple Wells.
2. The injection system is to be closed, with the use of a closed tank and seperator at the well site,.
3. The average injection pressure will be about 275 PSI, and will not exceed 500 PSI.
4. The water being deposed of is from the Gallup formation, and will be injected into the same formation.

Geological data on the Gallup Sandstone.

The Gallup Sandstone, a hydo-carbon producing horizon, is composed chiefly of medeum to fine grain clastic particles which form lenticular bodies within the lower portion of the Mancos shale. These lenticular bodies were deposited through a normal sequence of deltaic action. The Mancos shale was deposited along an oscillating shoreline and completely encloses the Gallup Sandstone. (Peterson, et. al.). Because of the deltaic action and osillating shoreline the Gallup Sandstone in the northern portion of the San Juan Basin is effectively isolated the interfingering of the Mancos Shale from the Gallup Sandstone, in the southern portion of the San Juan Basin.

The permeability of the Gallup Sandstone averages about 37 millidarcies throughout the formation. The porosity is close to 13.6 % with water saturation about 30% in some areas. The Gallup Sandstone has a fresh water aquifer in the southern portion of the San Juan Basin, but this aquifer is not continuous into the central or northern portions of the San Juan Basin.

The Gallup Sandstone formation will be utilized as the injection interval, This interval in the Malco Copple #6 well is between 3341- and 3462. The quality of fluids at this depth should be identical to the analysis of the water from the Sheila #1 well. Analysis report attached.

The density of the connate water combined with gravity should be sufficient for fluid transport into the Gallup Sandstone. If injection pressure shoud be necessary after a period of time, it should not eceed 342 PSI, as hydraulic fracturing might occur, thus causing a channeling effect.

The Geological information was taken from a report prepared by C.G.(Kris) Scroggins for Reeves Drilling & Petroleum Corp. on Malco Copple lease.

References

Bush, Daniel A.,(Stratigraphic Traps in Sandstone--Exploration Techniques), American Assos. Petroleum Geologist, Tulsa, Oklahoma, 1974, p. 61.

Peterson, James A, et. al. (Sedimentary History and Economic Geology of San Juan Basin, New Mexico and Colorado) in Subsurface Disposil in Geologic Bason-A Study of Reservoir Strata. John E. Galley, ed. American Assoc. Petroleum Geologist, Tulsa, Oklahoma, 1968, pp. 193, 226.

Warner, Don L., and Lehr, Jay H. (An introduction to the technology of Subsurface Waste Water Injection), Office of Research and Development, U.S. Enviromental Protection Agency, Ada, Oklahoma, 1977, pp, 293-316.

Well data on the proposed injection well.

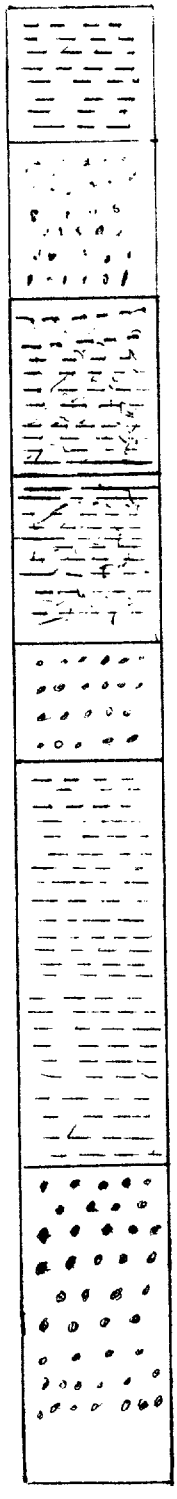
Lease Name - Malco Copple
Operator - Hebco Oil Company
Well name - Malco Copple #6 Section 5, Township 30 N., Range 15W
Field - Verde Gallup
Location - 1980' FNL 1980' FEL Sec. 5. Elevation 5425

Surface Casing - 10-3/4 - 32.75 lbs per ft. Set from 0-121' cemented with 120 sacks of cement, circulated to surface. Hole size for surface casing was 12 1/4". Production casing, 5 1/2" 15.50 lbs per ft. Set from 0-330', cemented with 150 sacks of cement. Circulated from 3341 to 1880'. Temp. survey on file. Production liner 4 1/2" - 15.50 lbs per ft. 138' set on bottom of hole. No cement.

The tubing that is going to be used is, 2 7/8" with 8 RD threads per inch. The make of tubing is J-55. The tubing will be set at 3341' with the cementing packer. We would then like to cement the entire tubing string from top to bottom. Due to possible holes in production casing from 1880 up to surface. Then have a temperature survey done to check cement. Bond. Then presure test tubing, then knock hole in cementing packer in order to start injecting into formation. Any future presure test on tubing would be done with retrievable 2 7/8" bridge plug.

The Gallup Sandstone will be the formation used to inject into. The well is located in the Verde Gallup field, San Juan County. The injection interval is 3341' to 3462'. This interval is an open hole with liner and no cement. The well was originally drilled as an oil well. The well makes small amounts of oil and water. There are no higher producing zones in this well. The next lower zone is about 200' deeper, and it is the GreenHorn Limestone. Surface is held by the BLM.

Malco Copple #6
Injection Well



Lewis Shale 0-675'

Cliffhouse 675-775'

Menefee 775'-1639'

Pointlookout 1639'-2030'

Mancos Shale 2030'-3134'

Gallup Sandstone 3134'-3462'

Sandstone

Shale

Sandyshale

Coal Seams

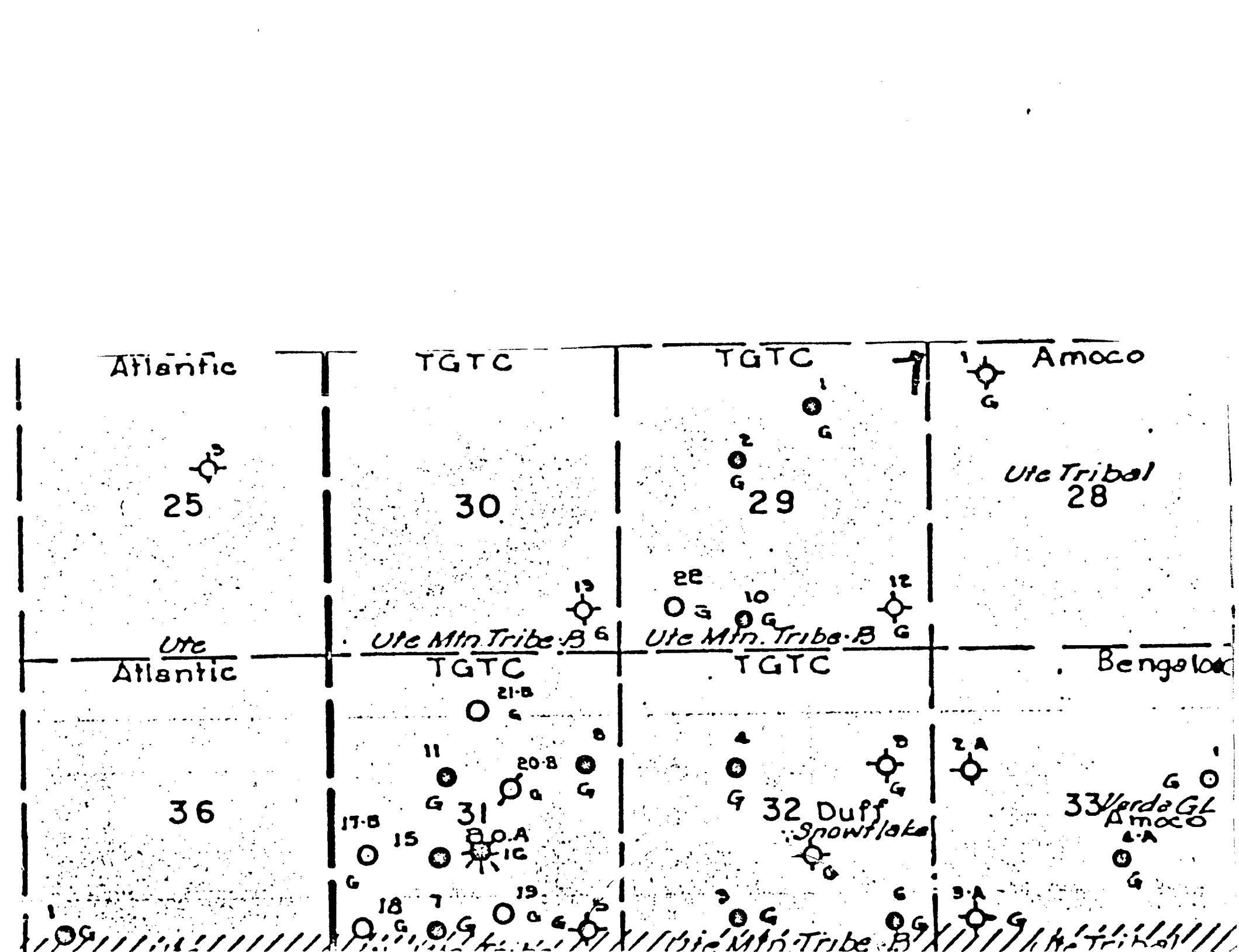
The only fresh water zone in the area of review, is the Pointlookout Sands. The depth to the bottom of the Pointlookout Sands in the proposed injection well is 2030'. There is no know source below the injection point, there has been no holes drilled below the Gallup on or around the area of reveiw.

There is no stimulation program planned on the injection well.

Logs are on file with the Division.

There are no fresh water wells within the area of reveiw.

We have examined the Geological and engineering data on the area, from the original studys done by El Paso Natural Gas Company, and have found no evidence of open faults or any other connection between injection zone and fresh water zones.


Atlantic
TGTC
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Snowflake
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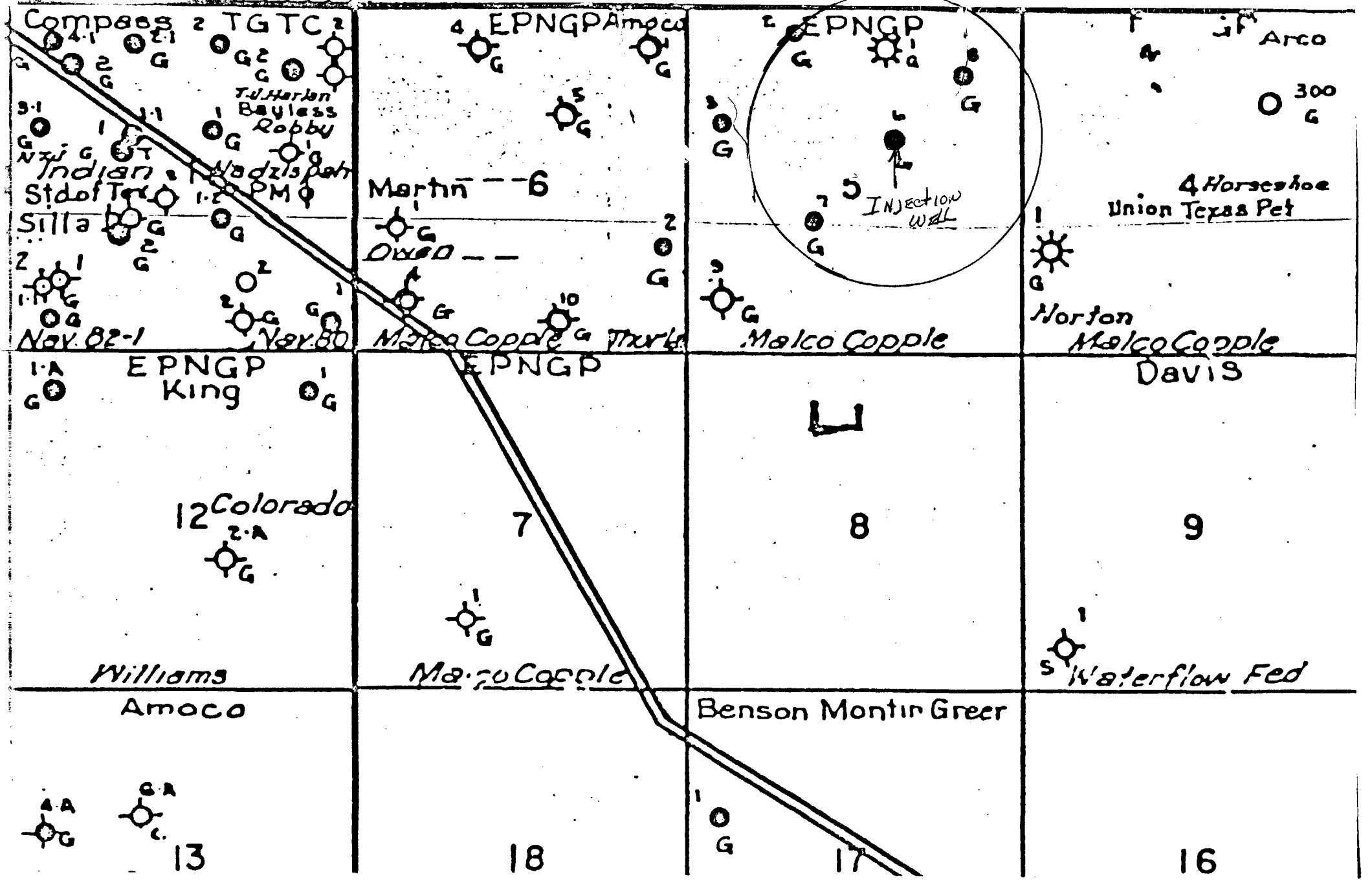
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T.J. Horton
Bayless
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Martin --6
Owen --
INJECTION WELL
5
4 Horseshoe
Union Texas Pet
Nov 82-1
Nov 80
Malco Copple
Norton
Malco Copple
EPNGP
King
EPNGP
Davis
12 Colorado
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Williams
Malco Copple
Waterflow Fed
Amoco
Benson Montin Greer
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APPENDIX A

NOWSCO SERVICES

P.O. Box 1079 • Farmington, NM 87401 • Phone 505-327-4911

API WATER ANALYSIS REPORT FORM

DATE 7/12/84
COMPANY Oklahoma Oil & Gas
SAMPLE NO. 1
DATE SAMPLED 7/10/84
FIELD Verde- Gallup
COUNTY OR PARISH San Juan
STATE New Mexico

TYPE SAMPLE Produced Fluid -- top of tank
DEPTH 2,775 '
FORMATION Lower Gallup
WELL NO. #1
LEASE Sheila
SAMPLED BY Denny Reeves
REPORT BY Ray Herndon

DISSOLVED SOLIDS

Cations	mg/l	me/l	x Valence =	Product
Sodium, Na & K	22,057		1	
Calcium, Ca	800		2	
Magnesium, Mg	267		2	
Barium, Ba	--			
TOTAL	23,124			

Anions				
Chloride, Cl	36,034		1	
Sulfate, SO4	0		2	
Bicarbonate, HCO_3	330		1	
Carbonate, CO_3	0		-	
TOTAL	36,364			

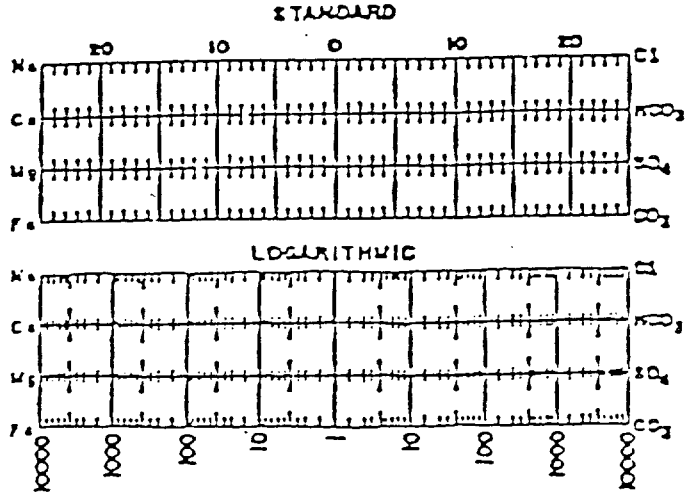
Total Hardness = 3,100
Total Dissolved Solids (calc.) 59,498 ppm

Iron, Fe (total) 10 ppm
Sulfide, as H_2S 0
Specific Gravity @ 1.042 @ 66°F

pH @ Temp. 5.0 @ 66°F
Resistivity 0.13 Ohm-meters
BHT °F

Remarks: Calcium Carbonate and Calcium Sulfate scaling tendencies is remote.

WATER PATTERNS — me/l.



Raymond A. Herndon

APPENDIX A

CALCIUM CARBONATE
Solubility Calculation
Stiff and Davis Extension of Langelier Method

EQUATION: $SI = pH - (K + pCa + pAlk)$

1. Perform standard water analysis.
2. Calculate ionic strength of water.

Ion	Concentration ppm (mg/l)		Conversion Factor		Ionic Strength (μ)	
$Na^{++} + K^{+}$	22057	x	(2.2×10^{-5})	=	48525	$\times 10^{-5}$
Ca^{++}	800	x	(5.0×10^{-5})	=	4000	$\times 10^{-5}$
Mg^{-}	267	x	(8.2×10^{-5})	=	2189	$\times 10^{-5}$
Cl^{-}	36034	x	(1.4×10^{-5})	=	50448	$\times 10^{-5}$
HCO_3^{-}	330	x	(0.82×10^{-5})	=	271	$\times 10^{-5}$
$CO_3^{=}$	0	x	(2.1×10^{-5})	=	0	$\times 10^{-5}$
$SO_4^{=}$	0	x	(2.1×10^{-5})	=	0	$\times 10^{-5}$
	Total ionic strength (μ)			=	105433	$\times 10^{-5}$

3. Determine K from Fig. 2A or 2B

   *Temperature = 5/9 (66 °F - 32) = 19 °C; K = 3.5

4. Determine pCa from Fig. 3

   Ca^{++} = 800 mg/l; pCa = 1.7

*5. Determine total alkalinity by adding HCO_3^{-} to $CO_3^{=}$

   HCO_3^{-} = 330 mg/l

   $CO_3^{=}$ = 0 mg/l

   Total Alkalinity = 330 mg/l; from Fig. 3, pAlk = 2.25

6. Add (K + pCa + pAlk) = (3.5 + 1.7 + 2.25) = 7.45

*7. pH = 5.0

8. SI = pH - (K + pCa + pAlk)

   = 5.0 - (7.45) = - 2.45

   If SI is negative, scaling is remote.

   If SI is positive, scaling is probable.

*Temperature, pH, HCO_3^{-} and $CO_3^{=}$ should be determined in the field on a fresh sample of water.

Anions

Cl^-	(ppm Cl^-) (0.0282)	= 1016
SO_4^{-2}	(ppm SO_4^{-2}) (0.0208)	= + 0
HCO_3^-	(ppm HCO_3^-) (0.0164)	= + 5
CO_3^{-2}	(ppm CO_3^{-2}) (0.0333)	= + 0
	Total Anions	= 1021

Cations

Ca^{+2}	(ppm Ca^{+2}) (0.0500)	= 40
Mg^{+2}	(ppm Mg^{+2}) (0.0820)	= + 22
	Total Cations	= 62

ppm Sodium and Potassium = (Total Anions - Total Cations) (23) = 22,057

XII. Resistivity Measurements:

Resistivity may be measured using either a resistivity meter or using tables which correlate specific gravity with total dissolved solids and resistivity. Resistivity is recorded in ohm-meters.

XIII. Total Dissolved Solids Determination:

The total dissolved solids is a total of all of the ions in solution recorded in parts per million (mg/l). This number may be approximated using the enclosed chart which relates specific gravity to total dissolved solids or more precisely by the following method:

Anions		Cations	
ppm Cl^-	36034	ppm Ca^{+2}	800
ppm SO_4^{-2}	+ 0	ppm Mg^{+2}	+ 267
ppm HCO_3^-	+ 330	ppm K^+ and Na^+	+ 22,057
ppm CO_3^{-2}	+ 0	ppm Fe	+ 10
Total Anions	36364	Total Cations	23134

(Total Anions) + (Total Cations) = Total Dissolved Solids = 59498 ppm

XIV. Inventory of Materials Needed for Water Analysis

Hardware:

APPENDIX B

CALCIUM SULFATE
Solubility Calculation
Skillman, McDonald and Stiff Method

EQUATION: $S = 1000 \left[\sqrt{X^2 - 4K_{sp}} - X \right]$

1. Perform standard water analysis.

2. Calculate ionic strength of water.

Ion	Concentration ppm (mg/l)		Conversion Factor		Ionic Strength (μ)	
$Na^+ + K^+$	22057	x	(2.2×10^{-5})	=	48525	$\times 10^{-5}$
Ca^{++}	800	x	(5.0×10^{-5})	=	4000	$\times 10^{-5}$
Mg^{++}	267	x	(8.2×10^{-5})	=	2189	$\times 10^{-5}$
Cl^-	36034	x	(1.4×10^{-5})	=	50448	$\times 10^{-5}$
*HCO_3^-	330	x	(0.82×10^{-5})	=	271	$\times 10^{-5}$
*$CO_3^=$	0	x	(2.1×10^{-5})	=	0	$\times 10^{-5}$
$SO_3^=$	0	x	(2.1×10^{-5})	=	0	$\times 10^{-5}$
			Total ionic strength	=	105433	$\times 10^{-5}$

*3. Temperature = 5/9 (66 °F - 32) 19 °C

4. Determine K_{sp} from Fig. 5; K_{sp} = 19E-5; $4K_{sp}$ = .0076

5. Calculate X.

Ion	Concentration ppm (mg/l)		Conversion Factor		M (mol/l)	
Ca^{++}	800	x	(2.5×10^{-5})	=	2000	$\times 10^{-5}$
$SO_4^=$	0	x	(1.04×10^{-5})	=	0	$\times 10^{-5}$

Subtract the smaller of the two values M from the larger.

$X = \Delta M = 2000 \times 10^{-5}$ $X = .02$; $X^2 = .0004$

6. Calculate S, solubility of $CaSO_4$ in brine.

$X^2 + 4K_{sp} = (.0004 + .0076) = .0080$; $\sqrt{X^2 + 4K} = .0894$

Total = $1000 \times (\sqrt{X^2 + 4K} - X) = 1000 \times (.0894 - .02) = S = 69.44$

7. Determine actual concentration of $CaSO_4$ in brine.

Ion	Concentration ppm (mg/l)		Equivalent Weight		mg/l Eq. Wt.	
Ca^{++}	800	÷	20	=	40	= meq/l
$SO_4^=$	0	÷	48	=	0	= meq/l

The actual concentration of $CaSO_4$ in the brine is the smaller of the two values.

Actual concentration of $CaSO_4$ 0 meq/l

8. Compare solubility (S) vs. actual concentration of $CaSO_4$.

S = 69.44 meq/l
Actual = 0 meq/l

If S is greater than actual, scaling is remote.

If S is less than actual, scaling is probable.

*Temperature, HCO_3^- and $CO_3^=$ should be determined in the field on a fresh sample of water.

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